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Lincoln College



Northeastern University
1984-86

Lincoln College Northeastern University 1984–86

*Day and evening programs in
engineering technology
science technology*

*Northeastern University
360 Huntington Avenue
Boston, Massachusetts 02115*

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*Northeastern University
Lincoln College
360 Huntington Avenue
Boston, Massachusetts 02115
Telephone 437-2500*

_____ 19 _____

Please send me an application for admission for:

- ☐ Lincoln College Evening Programs
- ☐ Day BET programs
- ☐ Will you please arrange for me to have an interview to discuss your program in

- _____
- ☐ I would like to apply for advance standing credit and shall arrange to submit transcripts of my records at all schools attended since high school.

Signature

Street Address

City

State

ZIP Code



Office Hours

Huntington Avenue Campus, Boston

September to June

Monday–Thursday 8:30 a.m.–8:00 p.m.

Friday 8:30 a.m.–4:30 p.m.

(Summer schedule subject to change)

Suburban Campus, Burlington

The bookstore is open from 8:00 a.m.–7:00 p.m. Monday through Thursday; 8:00 a.m.–4:00 p.m. on Friday; the Bursar's office is open from 8:30 a.m.–8:00 p.m. Monday through Thursday; 8:30 a.m.–4:30 p.m. on Friday.

Dedham Campus

Monday–Friday 8:00 a.m.–10:00 p.m.

Saturday 8:00 a.m.–1:00 p.m.

Program Counseling

Program counselors are available on a regular schedule at both the Boston campus and the Burlington campus. Appointments may be arranged by telephoning the Lincoln College office at 437-2500.

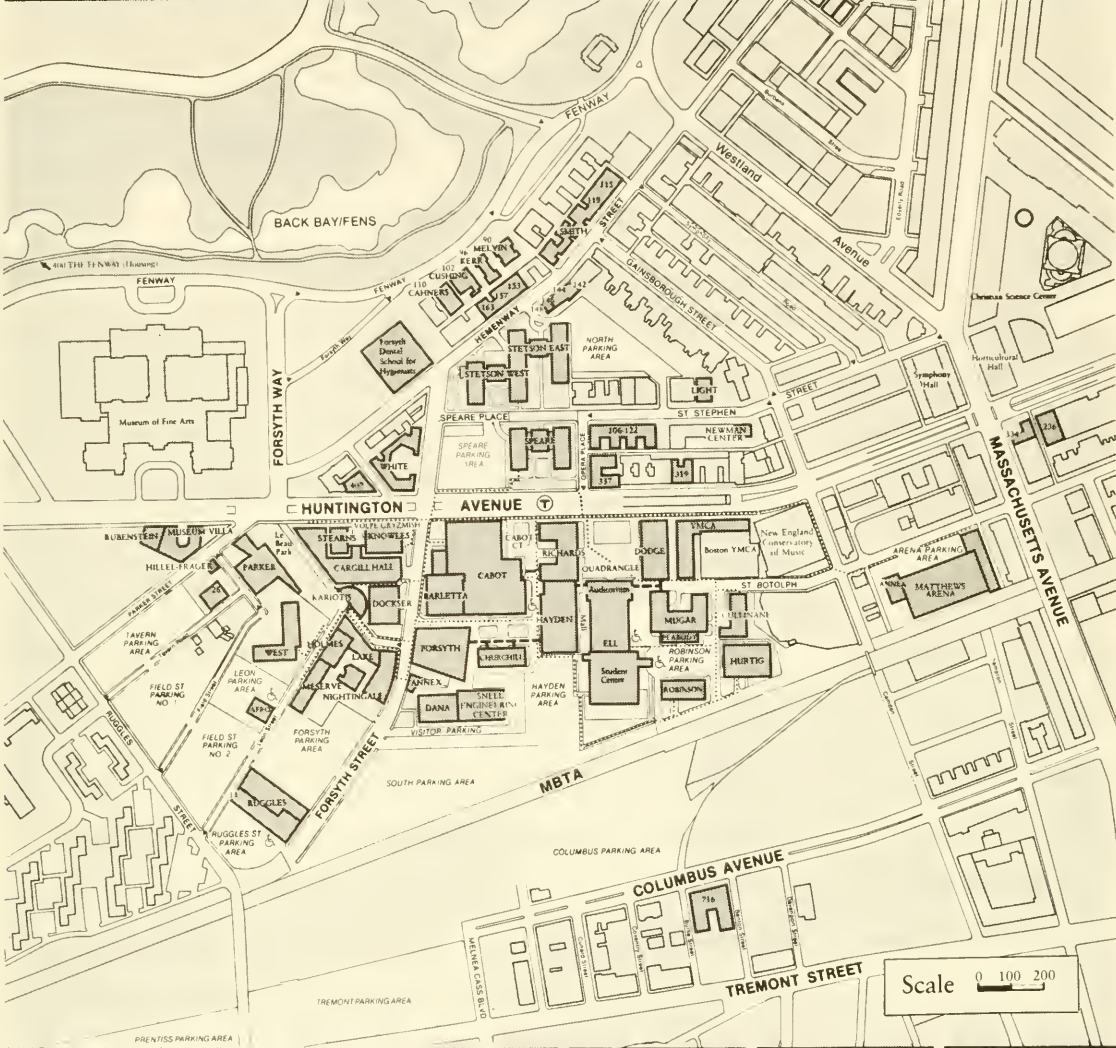
Interviews

Prospective students, or those desiring advice or guidance regarding any part of the school work or curricula, are encouraged to arrange for personal interviews. Career planning through competent guidance provides an understanding of professional requirements and develops that definiteness of purpose so vital to success. The Lincoln College office is located at 120 Snell Engineering Building on the Boston campus.

Address communications to:

Director
Lincoln College
Northeastern University
360 Huntington Avenue
Boston, Massachusetts 02115

The telephone number is: 617-437-2500.



A **B** **C** **D** **E** **F**

Academic and Service Buildings

- B** African-American Institute
- C** Barletta Natatorium
- DE** Boston YMCA
- C** Cabot Physical Education Building
- C** Cahners Hall
- B** Cargill Hall
- C** Churchill Hall
- D** 716 Columbus Avenue
- DE** Cullinane Hall (Botolph)
- C** Cushing Hall
- C** Dana Research Center
- B** Dockser Hall
- C** Dodge Library
- D** Ell Student Building (Auditorium)
- D** Ell Student Center (Student Lounge)
- C** Forsyth Building
- C** Forsyth Building Annex
- C** Hayden Hall
- A** Hillel-Frager
- B** Holmes Hall
- F** 236 Huntington Avenue
- DE** Hurtig Hall

- B** Kariotis Hall
- C** Kerr Hall (Faculty Center)
- B** Knowles Center (Gryzmish Hall)
- B** Knowles Center (Volpe Hall)
- B** Lake Hall
- F** 334 Massachusetts Avenue
- F** Matthews Arena
- EF** Matthews Arena Annex
- B** Meserve Hall
- D** Mugar Life Science Building
- D** (Peabody Health Professions Center)
- DE** Newman Center
- B** Nightingale Hall
- B** Parker Building
- C** Peabody Center
- C** Richards Hall
- D** Robinson Hall
- AB** Ruggles (11 Leon Street)
- C** Snell Engineering Center
- D** 122 St. Stephen Street
- B** Stearns Center
- A** 26 Tavern Road

Key

- Academic, Residential, and Service Buildings
- Handicapped Parking
- Handicapped Routes
- Parking Areas
- Public Buildings
- Public Parks
- Street Direction
- Underground Tunnel

Maps are provided by the Visitor Information Center, 115 Richards Hall, extension 2736. Some buildings on this map are used but not owned by Northeastern University. NUP 6.11.4

1984–85 Academic Calendar

times and dates subject to change

PART-TIME PROGRAMS

Fall Quarter 1984

Classes Begin Monday, September 24, 1984

Fall Registration Dates

Boston	5:00–7:30 p.m. 9:00–12:00 noon 5:00–7:30 p.m.	Tuesday–Friday, September 4–7 Saturday, September 8 Monday–Wednesday, September 10–12
Burlington	5:30–8:00 p.m. 12:00–3:00 p.m. and 5:30–8:00 p.m.	Monday and Wednesday, September 10 & 12 Tuesday, September 11
Belmont H.S.	5:30–8:00 p.m.	Thursday, September 6, and Tuesday, September 11
Brockton H.S.	5:30–8:00 p.m.	Wednesday, September 5, and Monday, September 10
Chelmsford H.S.	5:30–8:00 p.m.	Thursday, September 6, and Tuesday, September 11
Dedham Campus	5:30–8:00 p.m.	Thursday, September 6, and Tuesday, September 11
Framingham North H.S.	5:30–8:00 p.m.	Tuesday, September 4, and Monday, September 10
Lynnfield Middle School	5:30–8:00 p.m.	Thursday, September 6, and Tuesday, September 11
Marlboro H.S.	5:30–8:00 p.m.	Wednesday, September 5, and Monday, September 10
Marshfield H.S.	5:30–8:00 p.m.	Thursday, September 6, and Tuesday, September 11
Milford H.S.	5:30–8:00 p.m.	Tuesday, September 4, and Tuesday, September 11
North Attleboro H.S.	5:30–8:00 p.m.	Wednesday, September 5, and Monday, September 10
Revere (Abraham Lincoln School)	5:30–8:00 p.m.	Thursday, September 6, and Tuesday, September 11
Westwood H.S.	5:30–8:00 p.m.	Thursday, September 6, and Tuesday, September 11
Weymouth North H.S.	5:30–8:00 p.m.	Wednesday, September 5, and Monday, September 10
Fall Quarter Classes Begin		Monday, September 24
Columbus Day Observed	No Classes	Monday, October 8
Veteran's Day Observed	No Classes	Monday, November 12
Thanksgiving Recess	No Classes	Thursday–Saturday, November 22–24
Final Examination Period for Fall Quarter		Monday–Saturday, December 10–15
Christmas Vacation	No Classes	Monday–Tuesday, December 17–January 1

Winter Quarter 1985

Classes Begin Wednesday, January 2, 1984

Winter Registration Dates

Boston	5:00–7:30 p.m.	Monday–Thursday, December 3–6
Burlington	5:30–8:00 p.m.	Monday–Thursday, December 3–6
Belmont H.S.	5:30–8:00 p.m.	Tuesday, December 4
Brockton H.S.	5:30–8:00 p.m.	Monday, December 3
Chelmsford H.S.	5:30–8:00 p.m.	Tuesday, December 4
Dedham Campus	5:30–8:00 p.m.	Monday, December 3, and Tuesday, December 4
Framingham North H.S.	5:30–8:00 p.m.	Monday, December 3, and Tuesday, December 4
Lynnfield Middle School	5:30–8:00 p.m.	Tuesday, December 4
Marlboro H.S.	5:30–8:00 p.m.	Monday, December 3
Marshfield H.S.	5:30–8:00 p.m.	Tuesday, December 4
Milford H.S.	5:30–8:00 p.m.	Tuesday, December 4
North Attleboro H.S.	5:30–8:00 p.m.	Wednesday, December 5
Revere (Abraham Lincoln School)	5:30–8:00 p.m.	Tuesday, December 4
Westwood H.S.	5:30–8:00 p.m.	Tuesday, December 4
Weymouth North H.S.	5:30–8:00 p.m.	Tuesday, December 4, and Wednesday, December 5
Winter Quarter Classes Begin		Wednesday, January 2
Martin Luther King Jr.'s Birthday	No Classes	Tuesday, January 15
Presidents' Day	No Classes	Monday, February 18
Final Examination Period for Winter Quarter		Monday–Saturday, March 18–23
Spring Recess (or make-up period for lost snow days)		Monday–Saturday, March 25–30

Spring Quarter 1985

Classes Begin Monday, April 1, 1985

Spring Registration Dates

Boston	5:00–7:30 p.m.	Monday–Thursday, March 11–14
Burlington	5:30–8:00 p.m.	Monday–Thursday, March 11–14
Belmont H.S.	5:30–8:00 p.m.	Tuesday, March 12
Brockton H.S.	5:30–8:00 p.m.	Wednesday, March 13
Chelmsford H.S.	5:30–8:00 p.m.	Tuesday, March 12
Dedham Campus	5:30–8:00 p.m.	Monday, March 11, and Wednesday, March 13
Framingham North H.S.	5:30–8:00 p.m.	Monday, March 11, and Tuesday, March 12
Lynnfield Middle School	5:30–8:00 p.m.	Tuesday, March 12
Marlboro H.S.	5:30–8:00 p.m.	Monday, March 11
Marshfield H.S.	5:30–8:00 p.m.	Tuesday, March 12
Milford H.S.	5:30–8:00 p.m.	Tuesday, March 12
North Attleboro H.S.	5:30–8:00 p.m.	Monday, March 11
Revere (Abraham Lincoln School)	5:30–8:00 p.m.	Tuesday, March 12
Westwood H.S.	5:30–8:00 p.m.	Tuesday, March 12
Weymouth North H.S.	5:30–8:00 p.m.	Monday, March 11, and Wednesday, March 13
Spring Quarter Classes Begin		Monday, April 1
Patriot's Day Observed	No Classes	Monday, April 15
Memorial Day Observed	No Classes	Monday, May 27
Final Examination Period for Spring Quarter		Monday–Saturday, June 10–15
Commencement		Sunday, June 16

Summer Quarter 1985

Classes Begin Monday, June 17, 1985

Registration for Entire Summer Quarter

Boston	5:00–7:30 p.m.	Tuesday–Friday, May 28–31
Burlington	1:00–3:00 p.m. and 5:30–8:00 p.m. 5:30–8:00 p.m.	Tuesday, May 28 Wednesday, May 29
Summer Quarter Classes Begin		Monday, June 17

Registration for Second Five-Week Term

Boston	5:30–8:00 p.m.	Monday, July 8, and Tuesday, July 9
Burlington	5:30–8:00 p.m.	Monday, July 8
Independence Day Observed	No Classes	Thursday, July 4
Labor Day Observed	No Classes	Monday, September 2
Final Examination Period for Summer Quarter		Held during last class session each term

**Northeastern
University’s
Antidiscrimination
Policy**

Northeastern University is committed to a policy of equal opportunity for all students and employees without regard to race, color, religion, sex, sexual preference, national origin, or handicap or veteran status. The University prohibits discrimination in all matters involving admission, registration, and all official relationships with students, including evaluation of academic performance. Northeastern is also an equal opportunity employer.

**Equal Opportunity
Employment Policy**

Northeastern University is an equal opportunity employer. It is institutional policy that there shall be no discrimination against any employee or applicant for employment because of race, color, religion, sex, age, national origin, or handicap or veteran status.

Northeastern also prohibits discrimination against any employee regarding upgrading, demotion or transfer, layoff or termination, rates of pay or other forms of compensation, and selection for training. In addition, Northeastern adheres to Affirmative Action guidelines in all recruitment endeavors.

Further, Northeastern will not condone any forms of sexual harassment, which is defined as the use of unwelcome sexual advances, requests for favors, and other verbal or physical conduct of a sexual nature: as an explicit or implicit condition of employment, as the basis for employment decisions, or to interfere with an individual’s work performance by creating an intimidating, hostile, or offensive work environment.

Inquiries concerning our equal opportunity policies may be referred to the University Title IX Coordinator/Compliance Officer for Section 504 of the Rehabilitation Act of 1973, Affirmative Action Office, Richards Hall, (617) 437-2133.

**Emergency Closing
of the University**

Northeastern University has made arrangements to notify students, faculty, and staff by radio when it becomes necessary to cancel classes because of extremely inclement weather. AM radio stations WBZ (1030), WEEI (590), WHAV (1490), WHDH (850), WHUE (1150), WILD (1090), WJDA (1300), WKOX (1190), WLLH (1400), WMRE (1510), WNTN (1550), WRKO (680), WTTP (1060), and FM stations WBCN (104.1), WBOS (92.9), WCOZ (94.5), WFNX (101.7), WHTT (103.3), WRBB (104.9), WROR (98.5), WVBF (105.7), and WXKS (107.9) will announce the University’s decision to close. The TTY telephone number (a teletype machine) for the hearing impaired is 437-8516. Since instructional television courses originate from live or broadcast facilities at the University, neither the classes nor the courier services operate when the University is closed.

**Office of Services for
the Handicapped**

The Office of Services for the Handicapped (OSH) provides a variety of support services and general assistance to all Northeastern’s disabled students and employees. The University’s efforts to comply with the Rehabilitation Act of 1973 are coordinated by Ruth Bork, OSH Director, 5 Ell Center, (617) 437-2675.

Delivery of Services

The University assumes no liability, and hereby expressly negates the same, for failure to provide or delay in providing educational or related services or facilities or for any other failure or delay in performance arising out of or due to causes beyond the reasonable control of the University, which causes include, without limitation, power failure, fire, strikes by University employees or others, damage by the elements and acts of public authorities. The University will, however, exert reasonable efforts, when in its judgment it is appropriate to do so, to provide comparable or substantially equivalent services, facilities or performance, but its inability or failure to do so shall not subject it to liability.

The Northeastern University catalog contains current information regarding the University calendar, admissions, degree requirements, fees, and regulations, and such information is not intended to be and should not be relied upon as a statement of the University's contractual undertakings.

Northeastern University reserves the right in its sole judgment to promulgate and change rules and regulations and to make changes of any nature in its program, calendar, admissions policies, procedures and standards, degree requirements, fees, and academic schedule whenever it is deemed necessary or desirable, including, without limitation, changes in course content, the re-scheduling of classes, cancelling of scheduled classes and other academic activities, and requiring or affording alternatives for scheduled classes or other academic activities, in any such case giving such notice as is reasonably practicable under the circumstances.

Northeastern will do its best to make available to you the finest education, the most stimulating atmosphere, and the most congenial conditions it can provide. But the quality and the rate of progress of your academic career is in large measure dependent upon your own abilities, commitment, and effort. This is equally true with respect to professional advancement upon completion of the degree or program in which you are enrolled. The University cannot guarantee that you will obtain or succeed at any particular job; that will depend upon your own skills, achievement, presentation, and other factors such as market conditions at that time. Similarly, in many professions and occupations there are increasing requirements imposed by federal and state statutes and regulatory agencies for certification or entry into a particular field. These may change during the period of time when you are at Northeastern, and they may vary from state to state and from country to country. While the University stands ready to help you find out about these requirements and changes, it is your responsibility to initiate the inquiry because the University has no other way of knowing what your expectations and understandings are.

In brief, the University is there to offer you educational opportunities and choices and to assist you in finding the direction in which you want to steer your educational experience. But you are a partner in this venture with an obligation and responsibility to yourself.

Family Educational Rights and Privacy Act

In accordance with the Family Educational Rights and Privacy Act of 1974, Northeastern University permits its students to inspect their records wherever appropriate and to challenge specific parts of them when they feel it necessary to do so. Specific details of the law as it applies to Northeastern are printed in the *Student Handbook* and are distributed annually at registrations of University College and the graduate schools.

Fee Disclaimer

Tuition rates, all fees, rules and regulations, courses and course content are subject to revision by the President and the Board of Trustees at any time.

Accreditation

Northeastern University is accredited by the New England Association of Schools and Colleges, Inc., which accredits schools and colleges in the six New England states. Accreditation by the Association indicates that the institution has been carefully evaluated and found to meet standards agreed upon by qualified educators.



The University

Founded in 1898, Northeastern University is incorporated as a privately endowed, nonsectarian institution of higher learning under the General Laws of Massachusetts. The state legislature, by special enactment, has given the University general degree-granting powers. The University is governed by a Board of Trustees elected by and from the Northeastern University Corporation, which is composed of almost two hundred distinguished business and professional men and women.

From its beginning, Northeastern University has had as its dominant purpose the discovery of community educational needs and the meeting of these needs in distinctive and serviceable ways. The University has not duplicated the programs of other institutions, but has sought to pioneer new areas of educational service.

A distinctive feature of Northeastern University is its Cooperative Plan of Education, initiated by the College of Engineering in 1909 and subsequently adopted by the Colleges of Business Administration, Arts and Sciences, Pharmacy, Nursing, Boston-Bouvé College of Human Development Professions, Criminal Justice, Lincoln College's engineering technology programs, and by University College in a special pilot program. As an educational method, the Cooperative Plan offers students the opportunity to gain valuable practical experience as an integral part of their college programs, and also provides the means by which they may contribute to the financing of their education. The Plan has been extended to the graduate level in engineering, mathematics, rehabilitation administration, professional accounting, business administration, and law.

In the field of adult education, programs of study have been developed to meet a variety of needs. Since 1906, evening curricula have been offered leading to the bachelor's degree. Programs in the arts and sciences, engineering, various fields of business, law enforcement and security, and other areas have been carefully planned to serve mature students who are employed full time during the day and want to broaden their educational background by part-time study. All formal courses of

study leading to degrees through evening programs are approved by the Basic College faculties concerned and are subject to the same quantitative and qualitative standards as the regular day curricula.

Undergraduate Colleges

College of Arts and Sciences

The College of Arts and Sciences offers majors in the arts, humanities, social sciences, mathematics, and sciences leading to the bachelor of arts or bachelor of science degrees. Curricula are normally four years in length on a full-time plan or five years in length on the Cooperative Plan.

Boston-Bouvé College of Human Development Professions

Boston-Bouvé College offers programs of study leading to the degree of Bachelor of Science in Education in the fields of early childhood education, elementary education (with a minor in special education), human services, physical education, school and community health education, secondary education, and speech and hearing, Bachelor of Science in Recreation and Leisure Studies, and Bachelor of Science in Physical Therapy.

College of Business Administration

The College of Business Administration offers a five-year program of academic study and cooperative education leading to the Bachelor of Science degree in Business Administration. Students must complete a six-course concentration in Accounting, Human Resources Management Marketing, Finance and Insurance, Management, International Business Administration, Entrepreneurship and New Venture Management, Transportation and Physical Distribution Management, or a self-designed concentration.

College of Computer Science

The College of Computer Science offers a five-year cooperative education curriculum in Computer Science leading to the degree of Bachelor of Science in Computer Science. Areas of concentration within the program include operating systems, data base management, languages, and artificial intelligence.

College of Criminal Justice

The College of Criminal Justice offers a full-time day curricula on the Cooperative Plan, leading to the degree of bachelor of science.

College of Engineering

The College of Engineering offers five-year cooperative education curricula in civil (including an environmental engineering

option), mechanical, electrical (including a power systems option and a computer engineering option), chemical, industrial engineering, and information systems leading to the degree of bachelor of science with specification according to the engineering department in which the student qualifies. A more general program without specification leading to the bachelor of science degree is offered in which students design their curricula around a core of science, engineering science, and engineering courses. For highly qualified students, most departments offer a five-year program leading to both bachelor's and master's degrees in which students carry course overloads beginning in the third year. The college also offers, during evening hours, part-time programs leading to Bachelor of Science degrees in Civil, Mechanical, and Electrical Engineering, extending over eight years and meeting the same qualitative and quantitative standards of scholarship as the day curricula.

Lincoln College

Lincoln College offers engineering technology programs leading to the Associate in Engineering, the Associate in Science, and the Bachelor of Engineering Technology degrees. These programs are made available as:

1. A full-time day curricula on the Cooperative Plan leading to the degree of Bachelor of Engineering Technology (BET) in Mechanical or Electrical Engineering and Computer Technology.
2. A part-time evening program including pretechnology preparatory courses and degree programs leading to the Associate in Engineering (AE); and the Bachelor of Engineering Technology (BET) in Civil, Mechanical, or Electrical Engineering and Computer Technology.
3. Lincoln College part-time students whose work schedule does not permit them to attend regular evening classes may register for a maximum of eight quarter hours of course work per quarter in the Lincoln College day program.

Registration materials will be available Monday through Friday in Room 120 Snell Engineering Building, Boston Campus, only during the week preceding the start of each quarter. The day class schedule will not be available at other campus locations. The Registrar will not accept registration materials for day classes without the approval of the director of Lincoln College.

The day BET program is designed to meet the needs of the high school graduate, or the student transferring from a community

college or technical institute, who desires the full-time day curricula on the Northeastern Cooperative Plan.

In addition to its traditional curricula, Lincoln College Evening School offers interdisciplinary programs providing technological and professional development opportunities to meet the special needs of the part-time student. These programs are designed to provide trained people for ready assimilation by the engineering field and to give students the opportunity to prepare for the challenge of interfacing technology and society.

College of Nursing

The College of Nursing offers programs leading to a Bachelor of Science degree in Nursing, with special programs designed for registered nurses.

College of Pharmacy and Allied Health Professions

The College of Pharmacy and Allied Health Professions offers five-year cooperative curricula leading to the degree of Bachelor of Science in Pharmacy, Bachelor of Science in Respiratory Therapy, Bachelor of Science in Toxicology, and to the Bachelor of Science degree with majors in medical laboratory science and medical record administration. The Bachelor of Dental Hygiene is offered in cooperation with the Forsyth School for Dental Hygienists. Associate degree programs are offered in medical laboratory technology, respiratory therapy, and dental hygiene. In cooperation with the medical schools and teaching hospitals in the Boston area, the college offers a post-baccalaureate program for physician assistants.

University College

University College, so called because it draws upon resources of the other colleges of the University, offers part-time day and evening programs in arts and sciences, business administration, law enforcement, education, health professions, and therapeutic recreation service programs, leading to the associate in science, bachelor of arts, and bachelor of science degrees. It does not duplicate the offerings of the day colleges, but provides curricula which cut across traditional subject-matter areas to meet the particular needs of adult students. Students may pursue a degree or simply take courses, based on needs and interests, up to a total of thirty-nine or forty quarter hours of credit. Courses are offered in Boston as well as in Burlington, Framingham, Milford, Attleboro, Revere, Weymouth, Brockton, Marshfield, Sandwich, Belmont, Westwood, Dedham, Lynnfield, and Marlboro.

University College also offers two full-time day programs. The Radiologic Technology Program (28 months) and the Dental Assistant Program (1 year) are offered in cooperation with a variety of local clinical facilities. Each program has a separate application procedure and special requirements for admission.

Graduate Schools

Arts and Sciences

The master of arts degree may be earned in economics, english, history, political science, psychology, sociology, and social anthropology. The master of science degree is available in biology; chemistry; clinical chemistry; forensic chemistry; economics policy and planning; law, policy, and society; mathematics; and physics. The Master of Science in Health Science, the Master of Technical and Professional Writing, and the Master of Public Administration degrees are also offered. In addition, there are an advanced Literary Study Program leading to the certificate of advanced graduate study and programs leading to the doctor of philosophy degree in biology; chemistry; economics; law, policy, and society; mathematics; physics; psychology; and sociology. An interdisciplinary PhD program is offered in forensic chemistry with the College of Criminal Justice. Most programs may be completed through either full- or part-time study.

Boston-Bouvé College of Human Development Professions

The master of science degree may be earned, with specialization in counseling psychology, physical education, physical therapy, recreation and leisure studies, and speech-language pathology and audiology. Graduate courses in health education are available as electives within the College and for special students. Programs may be completed through full- and part-time study.

The master of education degree may be earned with specialization in career and industrial counseling, college student personnel work and counseling, curriculum and instruction, educational administration, educational research, human development, rehabilitation and special education, and school counseling. The certificate of advanced graduate study is offered in counseling psychology, counselor education, educational administration, and rehabilitation counseling. The doctor of education degree may be earned in leadership: administration and supervision, with specialization in counseling psychology, counselor education, educational administration, or rehabilitation administration.

Business Administration

A Master of Business Administration degree may be earned. The Graduate School of Business Administration offers a variety of programs to meet the needs and schedules of graduate business students. For those interested there are two program alternatives: a twenty-one-month Management Intern program, which includes a six-month, paid professional internship; or a two-year traditional full-time program, which may include ad-

ministrative or teaching assistantship opportunities. Individuals who wish to continue their full-time job responsibilities while earning an MBA degree may consider the evening part-time program of study, the eighteen-month Executive MBA program for upper-level managers, or the accelerated part-time High Technology MBA for qualified technical specialists. The master of science degree in professional accounting is an intensive, full-time program specifically designed for liberal arts and other nonaccounting majors. In addition, there is a program for advanced study in business administration leading to the Certificate of Advanced Study in Business Administration.

The Center for Management Development offers several intensive, graduate-level programs within the College of Business Administration. They are designed to provide professional growth and to improve the overall performance of experienced managers. Based on a modified Northeastern cooperative format, these programs permit company-sponsored participants to maintain their job responsibilities while attending classes. The Management Development Program spaces six weeks of in-residence instruction over four or five months, depending upon the choice of session. Sessions begin in October, January, and March on Phillips Academy campus in Andover, Massachusetts.

The Center also sponsors Management Workshops, scheduled one day each week for ten or twelve weeks at an off-campus facility. The three specialized workshops focus on core functional areas, advanced management concepts, or management in high-technology organizations.

Computer Science

The College of Computer Science offers the Master of Science degree in Computer Science.

Criminal Justice

The College of Criminal Justice offers both full- and part-time programs leading to a Master of Science degree in Criminal Justice and a Master of Science degree in Forensic Chemistry. Students enrolled in the Master of Science program in Criminal Justice may choose from several areas of specialization: administration and planning, criminology and research, and security administration. The Master of Science program in Forensic Chemistry provides an integrated survey of forensic science as utilized in criminalistic laboratories and related professional fields. An interdisciplinary PhD program in forensic chemistry is also offered with the College of Arts and Sciences, with specialization in forensic materials science, or forensic analytical chemistry. A further specialization is offered with the College of Pharmacy and Allied Health Professions. Students in either program attend classes during late afternoon and evening hours.

Engineering	<p>Master of science degrees are offered with course specifications in the fields of civil, chemical, electrical, industrial, mechanical, transportation, engineering management and information systems. A six-year program leading to both a bachelor's and master's degree is offered in electrical engineering, mechanical engineering, and power systems. Professional engineers degrees are offered in electrical, industrial, and mechanical engineering. We also offer a Women in Engineering program. PhD degrees are offered in civil, chemical, electrical, industrial engineering and information systems, and mechanical engineering. A doctor of engineering degree in chemical engineering is offered in addition to the PhD.</p>
Law	<p>The School of Law offers a full-time program of professional instruction leading to the degree of Juris Doctor (JD). The three-year curriculum includes twelve months of experience in law offices, governmental agencies, or other law-related employment. There are no courses for part-time or evening students.</p>
Pharmacy and Allied Health Professions	<p>The master of science degree is offered in biomedical science, clinical chemistry, hospital pharmacy, medical laboratory science, medicinal chemistry, and pharmacology. In addition, the master of health professions with options in health policy, regulatory toxicology, physician assistant, and a general option is available. The PhD degree is offered in biomedical science with specialization in medical laboratory science, medicinal chemistry, pharmaceutical science, pharmacology, and toxicology. An interdisciplinary doctoral degree is available in forensic toxicology. The clinically oriented Doctor of Pharmacy (PHARM D) degree is offered as a full-time program to graduates of accredited colleges of pharmacy.</p>
Professional Accounting	<p>The Graduate School of Professional Accounting is designed specifically for Arts and Sciences majors. The distinctive feature of the fifteen-month, full-time Master of Science degree program is a three-month paid internship with a public accounting firm.</p> <p>Some of the above programs are offered on the Cooperative Plan; others provide teaching and research fellowships for able candidates. The graduate schools are under the jurisdiction of the Basic College deans.</p>

Center for Continuing Education

The Center for Continuing Education was established to connect the University with various educational needs of its urban community. Its purpose is to assist both individuals and organizations who wish to keep pace with a society in the process of accelerated social and economic change. The center offers a wide range of workshops, conferences, institutes, forums, and special training programs in areas that include business, health, engineering, graphic arts, and food service. For more information, please write or call the Northeastern University Center for Continuing Education, 370 Common Street, Dedham, Massachusetts 02026; telephone 617-329-8000.

Office of Learning Resources

The Office of Learning Resources provides faculty, students, and staff with a variety of instructional services, equipment, and learning facilities.

The Learning Center furnishes students with individualized study and language lab facilities for remedial, supplementary, or enrichment purposes in many subject areas and in many formats—programmed texts, audiotapes, videotapes, and sound filmstrips, among others. A listening lounge, equipped with a stereophonic sound system, supplies a large selection of classical and popular prerecorded music. Students may use all facilities independently or to complete class assignments at no cost during day, evening, and weekend hours.

The Learning Resources Center is located in 406 Dodge Library and is open seven days a week. Telephone 437-2465 for further information.

The Media Production Laboratory provides facilities for both students and faculty for producing original materials, such as overhead transparencies, audiotapes, illustrations, slides, posters, and charts. Training is given in the use of all equipment, including that used for television production.

Campus Media Services makes available all types of audiovisual and video equipment and instructional materials for the support of classroom instruction on a prescheduled basis. Certain equipment is reserved for student use, and students may borrow instructional materials with faculty approval. A catalog of all instructional materials is available at no charge.

The Instructional Materials Center, which acquires and maintains the collection of University-owned instructional materials,

also provides a rental service for 16mm films and videotapes obtained from outside sources. Faculty who would like to evaluate instructional materials before purchase may do so through its preview service and facilities.

The Instructional Development Center assists individual faculty with specifying instructional goals, reviewing related literature and materials, examining alternative teaching strategies, producing learning materials, and evaluating course effectiveness. Its training in presentation and teaching techniques is complementary to its basic function of developing instructional units and courses.

Day Programs for Adults

These programs were developed to meet the needs of adults who wish to engage in part-time study during the day only. Noncredit courses and undergraduate and graduate degree programs are offered at the Boston and Burlington campuses. Included are courses from the Graduate School of Boston-Bouvé College of Human Development Professions, the Graduate School of Arts and Sciences, University College, and the Center for Continuing Education. A Human Relations and Adult Counseling program is also offered.

Affiliated Programs

Dental Hygienists

The Forsyth School for Dental Hygienists conducts a two-year and a four-year program of dental hygiene education and general education in cooperation with Northeastern University. Graduates of the two-year program receive the Certificate in Dental Hygiene from Forsyth and the degree of Associate in Science from Northeastern University. After receiving the associate degree, students may pursue the Bachelor of Dental Hygiene in the College of Pharmacy and Allied Health Professions or the bachelor of science degree in University College.

Health Record Administration

The University, in affiliation with several area hospitals, offers a three-year part-time evening program leading to certification in Health Record Administration for students who already hold a bachelor's degree and wish to qualify for the professional examination leading to registration as a record librarian.

Medical Technologists, Cytotechnologists, Hematologists

In cooperation with area teaching hospitals, Northeastern University offers a full-time day program on the Cooperative Plan leading to the degree of bachelor of science with concentration in medical technology.

Bachelor of science degree programs in Medical Technology and Hematology are offered on a part-time basis by University College in cooperation with several approved hospital schools.

Nurses

Northeastern University offers instruction in the sciences, humanities, and social studies for student nurses working for the associate or baccalaureate degree.

Physician Assistants

In cooperation with the Massachusetts Medical Society, Northeastern offers an eighteen-month program for the primary care physician assistant. Clinical rotations, supplemental to courses taken on campus, take place at Boston-area hospitals.

Radiologic Technologists

University College, in collaboration with several American Medical Association-affiliated hospitals in the New England area, conducts a program leading to eligibility for certification as a registered radiologic technologist and the associate in science degree. The program is accredited by the Joint Review Committee on Education in Radiologic Technology of the American Medical Association.

Respiratory Therapists

This program is conducted by the College of Pharmacy and Allied Health Professions in affiliation with local hospitals.

Buildings and Facilities

Main Campus

The main campus of Northeastern University is located at 360 Huntington Avenue in the Back Bay section of Boston. Many of the city's famous cultural, educational, and philanthropic institutions are situated in the Back Bay, including the Museum of Fine Arts, Symphony Hall, Horticultural Hall, the Isabella Stewart Gardner Museum, the Harvard teaching hospitals, and many schools and colleges. Most are within walking distance of Northeastern University.

Major transportation facilities serving the Boston area are Logan International Airport, two rail terminals, bus terminals serving inter- and intrastate lines, and MBTA subway-bus service within the metropolitan-suburban area. There is a subway stop in front of the campus. For motorists, the best routes to the campus are the Massachusetts Turnpike (Exit 22) and Route 9, of which Huntington Avenue is the intown section.

The campus of fifty acres is divided by Huntington Avenue, with the main educational buildings on one side and dormitories on the other. The principal buildings, all of which have been constructed since 1938, are of glazed brick in contemporary classic style. Some are interconnected by underground passageways.

University Library System

The University library system includes the Dodge Library and the three graduate libraries: chemistry, which includes chemical engineering, biology, pharmacy, and the health services; physics/electrical engineering, 324 Dana Hall; and mathematics/psychology, 531 Nightingale Hall. The Suburban Campus library supports the programs at Burlington and Dedham. Other collections are at the Marine Science and Maritime Studies Center in Nahant, at the Dedham campus, and at the Center for Management Development in Andover. There is also the law library located in the Knowles Center.

The University library collections consist of over 510,000 bound volumes and nearly 570,000 microforms. The periodical titles number almost 3,800; additional continuation titles, 1,300; and sound recordings, 10,000.

The Northeastern libraries have computerized many operations internally and, in addition, hold membership in the New England Library Information network. NELINET has been established for the purpose of developing and operating major library support services. It is a network of libraries devoted to sharing financial, human, and material resources to reduce cost and redundancy and to expand the timeliness and variety of services available.

Library Hours

Dodge Library

Mon.-Thurs.	7:45 a.m. to 10:00 p.m. (10:00 p.m. to midnight)*
Friday	7:45 a.m. to 7:30 p.m.
Saturday	12:00 noon to 4:00 p.m. (4:00 p.m. to 10:00 p.m.)*
Sunday	12:00 noon to 4:00 p.m. (4:00 p.m. to midnight)*

Divisional Libraries

Mon.-Thurs.	8:30 a.m. to 10:00 p.m.
Friday	8:30 a.m. to 7:30 p.m.
Saturday-Sunday	Closed

Suburban Campus Library, Burlington

Mon.-Thurs.	8:30 a.m. to 9:00 p.m.
Friday	8:30 a.m. to 5:00 p.m.
Saturday	8:30 a.m. to 1:00 p.m. (alternate Saturdays)
Sunday	Closed

*References and Periodicals; for study only.

The George and Hope Matthews Arena

Two blocks and a right turn away from the main quadrangle on Northeastern University's Boston campus is the oldest indoor ice hockey arena in the United States, one of the focal points for amateur athletics in the Boston area. With more than a million and a half dollars already invested for major renovations, the arena is a credit to the community. The building is used primarily for collegiate sports, especially men's and women's basketball and hockey contests, as well as other recreational activities. Northeastern also makes the arena available to the community for certain events.

Ell Student Center

The Carl S. Ell Student Center provides facilities for student recreation and extracurricular activities. The Alumni Auditorium, with a seating capacity of 1,300, is part of the center. Also included are special drama facilities, a ballroom, main lounge, fine arts exhibition area, student offices, conference rooms, and a dining area seating more than 1,000.

Lane Health Center

A comprehensive program of medical care is provided to all full-time graduate and undergraduate students. The University maintains a Health Services clinic in the Forsyth Building, Room 135, which is open for emergencies at all times and is equipped to deal promptly with any medical condition that may arise. All entering new students must submit a pre-entrance physical examination form provided by the Lane Health Center prior to registration. Failure to fulfill this requirement can delay registration and result in a penalty fee and an additional fee for a physical examination. Regular clinic hours for the student body are held by staff physicians from 9:00 a.m. to 4:30 p.m., Monday through Friday. Health Services can be reached at all times by telephoning 437-2772.

Counseling and Testing Center

Counseling and testing to aid a student or prospective student with career, educational, or personal concerns are available days and certain weekday evenings until 8:30 p.m. Information and appointments may be obtained by calling 437-2142 or by visiting the Counseling and Testing Center, 302 Ell Student Center.

Office of Services for the Handicapped

Any student who has a disability-related special need can receive ready support services from the Office of Services for the Handicapped (OSH). OSH provides a wide range of support services to eliminate the competitive disadvantages that a disability may create. Services are individually tailored to meet the needs of each student.

The following types of assistance are available from the Office of Services for the Handicapped: orientation; registration and preregistration; counseling; housing; services for the visually impaired students, for the hearing-impaired student, and for the wheelchair user/mobility-impaired student; information clearinghouse.

The Office of Services for the Handicapped is also the gathering place for the Disabled Student Organization of Northeastern University, which works cooperatively with OSH to plan programs and improve accessibility of services for handicapped persons at Northeastern. For further information please call OSH at 437-2675 (voice) or 437-2730 (TTY).

Academic Computer Sciences

Academic Computer Services, located in the basement of Richards Hall (telephone: 437-2334), supports research activities of faculty, research personnel, and graduate students, as well as teaching and learning activities at both the graduate and undergraduate levels. The computational capability of this facility is supplied by three Digital Equipment VAX-11/780 systems

and one Data General MV/8000 system. Each of these systems is a state-of-the-art 32-bit virtual memory machine optimized for interactive computing. In addition, there are ten Digital Equipment LSI-11 microcomputers, each configured with dual floppy disks and video terminal. For more advanced applications, there also exists a multiterminal Computervision Computer-Aided-Design/Computer-Aided-Manufacturing (CAD/CAM) system.

Both students and faculty access these systems in a time-sharing environment through video and hard-copy terminals arranged in student and faculty clusters at Boston, Burlington, and Dedham campuses. There are also a number of dial-in telephone lines, primarily for faculty use. Color-graphics devices and word-processing packages are also available. The primary languages supported are FORTRAN, COBOL, BASIC, Pascal, and Assembler. Numerous software libraries are available for numerical, statistical, and financial applications. Both faculty and students can readily obtain programming assistance in order to promote effective utilization of all facilities.

Cabot Physical Education Center

The Godfrey Lowell Cabot Physical Education Center is one of the best equipped in New England. The large gymnasium contains four basket-ball courts. In addition, the center consists of an athletic cage and a small gymnasium as well as administrative offices for the Department of Athletics and for the Physical Education Department of Boston-Bouvé College of Human Development Professions.

A recent addition to the center, the Barletta Natatorium, houses a 105-foot swimming pool, a practice tank for the crew, handball and racquetball courts, and shower and dressing facilities.

Dockser Hall

Charles and Estelle Dockser Hall, completed in 1968, houses a large gymnasium, dance studio, motor performance laboratory, college library, community recreation laboratory, folk arts center, dark and music rooms, recreation resources area, locker rooms, offices, classrooms, conference room and lounge, storage facilities, and a research laboratory.

Suburban Facilities

The Burlington Campus

This campus consists of two buildings and is located near the junction of Routes 95(128) and 3 in Burlington, Massachusetts, thirty-five or forty minutes from the main campus in Boston.

This campus has classrooms, computer terminals, an auditorium, bookstore, library, and a cafeteria. A wide variety of academic programs is offered at this facility.

The Dedham Campus One of Northeastern University's newest additions, it is located on Route 135, less than a mile from Route 128. This campus contains eleven classrooms, two executive case-study rooms, a dining area, and a computer room. The Dedham campus has a number of seminar rooms that are used for the high technology and executive MBA programs, as well as for University College's Center for Continuing Education.

Henderson House Located in Weston, Massachusetts, Henderson House serves as a conference center. Used for both large and small conferences and meetings, its facilities include conference rooms, dining services, and some overnight accommodations.

Marine Science and Maritime Studies Center The center is located about twenty miles northeast of Boston in Nahant and is in operation all year. It is a research and instructional facility primarily engaged in the study of marine biology and oceanography. Many of the courses at the center are applicable toward an advanced degree in biology or health science.

The Warren Center Located in Ashland, the Warren Center is a practical laboratory in outdoor education and conservation for Northeastern's Boston-Bouvé College of Human Development Professions. Facilities include tennis courts, athletic fields, swimming and boating, fields and forests, as well as a recreation hall, dining facilities, and conference accommodations.

Lincoln College Administration

Administrative Officers

Thomas E. Hulbert, BMgtE, MS, PE, *Director*

Jacob Wiren, BS, MS, PE, *Assistant Director*

Rasma Galins, BS, *Assistant to the Director*

Richard D. Mansfield, BS, *Assistant to the Director*

Jane E. DeVoe, BS, MA, *Counselor*

Student Counseling Staff

Rasma Galins, *Administrative Coordinator*

Philip W. Dunphy, BS, MEd

Peter Franks, BA, MEd

Richard E. Sprague, BS, BBA, MBA, EdM

Kenneth S. Woodard, BS, ME, AGIIGI (Federal)

Jane E. DeVoe, BS, MA

Committee on Regulations and Discipline

Thomas E. Hulbert, *Chair*

Richard D. Mansfield

Jane E. DeVoe

Rasma Galins

President, Adult Student Council

Academic Standing Committee

Thomas E. Hulbert, *Chair*

Jane E. DeVoe

Jacob Wiren

Richard D. Mansfield

Stephen M. Kane

Ernest E. Mills

Louis J. Nardone

Leroy M. Cahoon

Nona K. Lehmkuhl

Rasma Galins

Academic Advisory Council

Thomas E. Hulbert, *Chair*

Jacob Wiren, *Vice Chair*

Edward Bobroff

Leroy M. Cahoon

Rasma Galins

Francis R. Hankard

Walter Messcher

Ernest E. Mills

Louis J. Nardone

Curriculum Advisory Committee

Thomas E. Hulbert, BMgt, MS (Academic Administration), *Chair*
Jacob Wiren, BS, MS, PE, *Vice Chair*
Rasma Galins, BS, *Secretary*
Richard D. Mansfield, BS
Jane E. DeVoe, BS, MA
Robert J. Averill, BS, MS (Circuit Theory & Trans. in Linear Systems)
Ralph S. Blanchard, Jr., BS, MS, PE (Mechanical Engineering Electives)
Edward Bobroff, BME (Program Consultant, Mathematics)
Franklyn K. Brown, BS, MEd (Engineering Design)
Leroy M. Cahoon, BSCE, MS, PE (Program Consultant, Civil Engineering Technology)
Robert W. Case, PhD (Coordinator, Day Mathematics)
Roger T. Connor, AB, MEd (Course Consultant, Calculus)
William V. Durante, BS, MEd, MA (Freshman Mathematics)
William D. Finan, AB, MA, DEd (Introductory Mathematics)
Peter D. Gianino, BS, MS (Differential Equations)
David Goldberg, BS, MSEE, MSEM (Electrical & Electronic Graphics)
Francis R. Hankard, SB, MA (Program Consultant, Physics)
John Kaczorowski, Jr., BS, MS (Electronic Labs.)
George F. Kent, BS, MS, PE (Materials)
Robert S. Lang, BS, EdM (Engineering Graphics)
Demetre P. Ligor, BSEE, PE (Course Consultant, Physics)
Bertram S. Long, BS, MS, ME (Stress Analysis, Adv. Stress Analysis)
Anton Mavretic, BS, MS, PhD (Linear Active Cir. Des., Electronics, & Prin. of Comm. Systems)
Michael V. McAulay, BS (Technical Communications)
Robert L. Meserve, BS, MS (Fluid Mechanics)
Walter Messcher, BME, MS (Program Consultant, Computer Technology)
Ernest E. Mills, BS, MS, PE (Program Consultant, Mechanical Engineering Tech., Day and Evening Programs)
Louis J. Nardone, BS, MS, PE (Program Consultant, Electrical Engineering Technology, Day and Evening Programs)
Charles H. Price, Jr., BSEE, MSEE (Analog, Digital & Hybrid Computers, Digital Systems)
Edward L. Rich, BS, MS, PE (Mechanical Tech. Laboratory)
Raimundas Sukys, BS, MS (Pulse Circuits, Integrated Circuits)
James Welch, BS, MS (Microprocessor Hardware)
Albert G. Wilson, Jr., BS, CE, MS, PE (Mass.), SE (Illinois) (Statics and Dynamics)

Office Staff

Kordi N. Heidel, *Secretary*
Elsie Chan, *Secretary of Exams*
Rosanne L. Bogan, *Secretary of Records*
Marjorie A. Blanch, *Clerk-Typist*



The Role and Scope of Lincoln College

Purpose

Lincoln College is charged with the responsibility for developing and offering college-level courses and curricula of an applied-science or technological nature. Its purpose is to educate technologists to assist professional personnel in dealing with the applications and uses of the biological, natural, and physical sciences in better meeting community needs. The programs of study conducted by the college have in common the following purposes and characteristics:

1. They offer the student the opportunity to prepare for activities allied to the fields of engineering, science, or medicine, but are more specialized than those required to prepare a person for full professional responsibilities.
2. They are more concise and more completely technological in content than professional curricula, although they are concerned with the same general fields of scientific, engineering, industrial, or clinical specialization.
3. They are based upon principles of science, and include post-secondary school mathematics to provide the tools to achieve the technological objectives of the curricula.
4. They emphasize the use of rational processes in converting theories and ideas into practical techniques, procedures, and products.
5. Extensive training for artisanship or craftsmanship is not included within the scope of the technological education programs.
6. Graduates from the associate degree programs have opportunities for educational work leading to the Bachelor of Engineering Technology and bachelor of science degrees.

Technology and the Technologist

Scientific and technological skills range over a broad spectrum, from extremely simple craftsmanlike activity to highly complex and abstract activity. At one end of the spectrum is the professional whose work is mostly theoretical in character. He or she studies, reasons, and visualizes how new knowledge may be used in the development of solutions to technical problems. This person usually is not completely knowledgeable in the detailed procedures used by the skilled craftsman who executes the ideas, procedures, and designs.

The technologist is the pivot-person on the professional-technologist-craftsman team. The technologist usually works with the professional engineer, scientist, doctor, or supervisor, and with the craftsman in converting knowledge of scientific theories and practical craftsmanship into products, procedures, and techniques.

When employed in research, design, or development, the technologist usually acts as direct supporting personnel to the professions. Functioning in a capacity related to production, operation, testing, or control, he or she usually follows a course prescribed by a professional, but may not work closely under the professional's direction. If installation, maintenance, or sales are the areas of responsibility, the technologist is frequently performing a task that would otherwise have to be performed by the professional, thereby assuming the more routine professional functions demanded by our increasingly scientific and technical society.

In executing all functions, the technologist is normally required to use a high degree of rational thinking and to employ post-secondary school mathematics and the principles of the biological, natural, and physical sciences. The skilled technologist works with the mind as well as the hands, and considers why, as well as how, things work. The technologist must effectively communicate technical and scientific information mathematically, graphically, and linguistically.

The Need for Technologists

Our present technological age, with its exploding accumulation of new information and discoveries in the physical, natural, and life sciences, has increased the need for people with specialized training in science and technology. Experts have recently estimated that in order to meet expanding needs, the number of students graduating from the nation's professional schools must double—a goal which is improbable in the near future.

The most reasonable alternative is to make our professional manpower most efficient by providing assistance in the form of

specially trained technologists. Manpower experts believe that the present ratio of less than one technologist to each professional should ideally be nearer five to one.

Opportunities for technologists are increasing. The technologist's employment opportunities are varied and include positions in health and public service organizations; atomic energy and electric power industries; metal fabricating industries; local, state, and federal government agencies; the armed forces; aerospace industries; chemical, petroleum, plastics, and metal industries; and transportation and communication industries, among others.

Programs of Instruction

Recognizing the growing need for technicians and technologists and their expanding role in modern society, Lincoln College offers Pre-Technology Preparatory Courses and degree programs leading to the Associate in Engineering (AE), Associate in Science (AS), and Bachelor of Engineering Technology (BET) degree as follows:

Pre-Technology

page 55	Introductory Mathematics, Physics, and English
page 55	Reading Improvement Program (noncredit)
page 56	Programmed Study Review Courses (noncredit)

Civil Engineering Technology

page 58	Architectural Engineering Technology (AE degree)
page 59	Environmental Engineering (AE degree)
page 60	Structural Engineering Technology (AE degree)
page 61	Surveying and Highway Engineering Technology (AE degree)
page 62	Civil Engineering Technology (BET degree)

Electrical Engineering Technology

page 65	Electrical Engineering Technology (AE degree)
page 66	Electrical Engineering Technology (BET degree)
page 68	Electrical Engineering Technology (BET degree) (Day Cooperative Curriculum)

Mechanical Engineering Technology

page 71	Mechanical Engineering Technology (AE degree)
page 72	Mechanical Engineering Technology (BET degree)
page 74	Mechanical Engineering Technology (BET degree) (Day Cooperative Curriculum)
page 76	Aerospace Maintenance Engineering Technology (BET degree) (Day Cooperative Curriculum)

Interdisciplinary Science and Engineering Technology Programs

page 78	Telecommunications (AS degree)
page 79	Computer Technology (AE degree)
page 80	Computer Technology (BET degree)
page 82	Computer Technology (BET degree) (Day Cooperative Curriculum)
page 84	Mechanical-Structural Engineering (BET degree)

College of Engineering

Part-time Electrical, Civil, and Mechanical Engineering Programs (BS degree)

These programs are designed for fully qualified young men and women who:

1. because of family responsibilities must continue to be gainfully employed full time during the day, but who wish to advance by devoting leisure time to their own professional development;
2. were in the top half of their high school class, but at graduation were financially unable to continue their education at the college level; those who did not enjoy top-half standing may require refresher study;
3. realize that the most effective way to achieve their full potential in these days of specialization is to earn a college degree.

All courses in these part-time curricula are identical with those offered in the five-year, day cooperative programs and are taught by the same faculty.

The University reserves the right to withdraw, modify, or add to the courses offered or to change the order or content of courses in any curriculum.

Admission Requirements for the College of Engineering

It is important that applicants for admission to the College of Engineering complete the full sequence of secondary school courses in English, mathematics, and science. The following subjects should be included: English (four years), physics or chemistry, algebra (through quadratics), plane geometry, and trigonometry.

Admission testing requirements may be met in one of three ways:

1. by submitting the results of the College Board Scholastic Aptitude Test previously completed;
2. by writing the College Board Scholastic Aptitude Test during the current year (the Committee on Admissions provides full information about the Scholastic Aptitude Tests);
3. by completing a special battery of tests in the Northeastern University Counseling and Testing Center, Room 302, Ell Student Center.

A transfer student applying for advanced standing need not complete testing.

In evaluating the credentials of applicants, the Committee on Admissions takes into account additional study which may have been completed since secondary school and, where relevant, armed forces experience.

Applying for Admission to the College of Engineering

Applications for freshman admission and admission with advanced standing may be obtained by writing to the Department of Admissions, 150 Richards Hall, or they may be secured during an admissions interview.

A personal interview is not required, but all candidates are welcome to make an appointment with an admissions counselor. Interviews may be scheduled from 8:30 a.m. to 4:00 p.m., Monday through Friday, and on Saturday from 9:00 to 11:30 a.m.

The candidate will be notified of the decision of the Committee on Admissions as soon as all credentials have been received and evaluated.

Candidates who have successfully completed courses at other institutions and who wish to transfer to Northeastern should read the following information concerning special transfer programs.

Civil and Electrical Engineering Transfer Programs for Associate Degree Graduates

Students with an associate degree from an (ABET) accredited technical institute, community college, or junior college with a 2.5 cumulative average or better ($C = 2.0$) will be considered for admission to a special transfer program and complete the civil or electrical engineering degree in five years. Students whose associate degree program did not include a minimum of one year of both calculus and physics will not be eligible for entry at this level.

Civil, Electrical, and Mechanical Engineering Transfer Programs for Bachelor of Engineering Technology Graduates

Students with a bachelor of engineering technology degree or its equivalent from an (ABET) accredited college or university, with a 2.75 cumulative average or better ($C = 2.0$), may be eligible to complete one of the specified Bachelor of Science in Engineering programs by taking a *minimum* of 40 quarter hours (10 courses) of work. The courses to be taken are assigned by a departmental adviser and are based whenever possible on the student's previous background. Students who have a Bachelor of Engineering Technology, Bachelor of Science in Engineering

Technology, or a Bachelor of Science in Engineering degree that is not professionally accredited may be required to take significantly more courses.

All Other Transfers to the College of Engineering

Students with previous academic experience not covered in the above categories will be placed at an appropriate point in the program they select, based on a course-for-equivalent-course credit evaluation.

Questions concerning these programs may be referred to the Department of Admissions (437-2213), or to the Office of the Dean of the College of Engineering (437-2152).

The Academic Year

Each academic year is composed of four quarters, beginning late in September and ending early in September. Full details with regard to registration are mailed approximately one month in advance. The programs are offered only at the Boston campus.

Schedule of Classes

Class will normally meet two evenings each week, and occasionally on Saturday morning. Laboratory classes meet during additional evenings.

Admissions Information

Admission

The Student Body

The student body of Lincoln College is composed of recent high school graduates and mature men and women. Most students are employed in industry, with vocational experience ranging from very little for the recent secondary school graduate, to as much as twenty or thirty years for individuals seeking increased professional responsibility and status. Many technical career categories are represented—industrial, engineering, scientific, and allied-medical—demonstrating that, in our increasingly complex society, the key to personal advancement is education.

Northeastern University is authorized under federal law to enroll nonimmigrant alien students.

Academic Background

A firm knowledge of the fundamentals of mathematics and science is the foundation upon which successful achievements in the more advanced technological courses are built.

Applicants to Lincoln College are, in many cases, mature adults who, although they have experience in industry or previous education, have been away from formal study for some time, and therefore have doubts concerning their study habits and their algebra, geometry, and science proficiency. Those who anticipate some difficulty in adjusting to the first-year course requirements are advised to give very serious consideration to enrolling in courses in introductory mathematics, or introductory physics. These courses are designed to develop adequate background for the basic courses in the degree programs.

Program Counseling

Career planning through self-analysis and professional counseling assists students in planning educational programs appropriate to their objectives. Entering students are encouraged to arrange for personal interviews with Lincoln College program counselors for assistance in planning their academic programs. Counselors are available by appointment at the Huntington Avenue Campus, Boston, and at the other Lincoln College cam-

puses listed at the front of this catalog. Students are encouraged to present records of prior education whenever possible. The effectiveness of the counseling review is greatly enhanced by this information. The University, through its Counseling and Testing Center and its Career Information Center, is also prepared to assist applicants whose educational and vocational goals are more complex or less firmly defined.

Application for Admission

Information concerning admission may be obtained either by writing to Lincoln College or by requesting it at the time of visiting the College. The application for admission should be completed in detail and submitted to Lincoln College, Northeastern University, Boston, Massachusetts 02115.

All inquiries relative to the day cooperative programs should be referred to the Day College Admissions Office, 150 Richards Hall. (See pages 43 and 53–54.)

Mathematics Placement Test

Applicants requesting admission to regular first-year mathematics are required to demonstrate proficiency in introductory or basic mathematics through the Lincoln College mathematics placement test. Students who request enrollment in the Introductory Mathematics course are not required to take the test. The mathematics placement test will be administered during the registration period for each term of instruction at the Huntington Avenue campus, Boston, and the Suburban Campus, Burlington. The mathematics placement test will be administered on selected dates at the Lincoln College campuses listed at the front of this catalog. In addition, the test is administered during the summer months. Contact the Lincoln College office, 120 Engineering Building, at the Boston campus (437-2500).

Students who demonstrate satisfactory proficiency in the test will be permitted to register for the first-year courses in the program of their choice. To enroll in Engineering Physics (PHY 4117) the student may need to take Introductory Physics.

If need for a strengthening of mathematical background is indicated, the applicant will be assigned to the Introductory Mathematics course.

Students enrolling in Introductory Mathematics may fill out their schedule by enrolling in Introductory Physics, or Engineering Graphics.

In every case the student should carefully consider the combined work and study load and register for only those courses which contribute to the development of a firm knowledge of fundamentals and which enable the student to adjust to academic study requirements.

Classification of Students

Applicants who have filed an application for admission and who are approved by the Lincoln College Academic Standing Committee are admitted as regular students in the program that they have indicated on the application.

Special Students

Students having specific course needs, who do not desire a degree, may register for the courses if they have the required prerequisites or their equivalent. These students will be enrolled as "special students."

Matriculation

Petition forms of admission to the status of a degree candidate are available at offices on all Lincoln College campuses (see page 31).

To matriculate:

1. A student who has completed sixteen quarter hours of credit in the curriculum of a Lincoln College degree program may file a matriculation petition to be recognized as a degree candidate.
2. The student must have a high school diploma or its equivalent and must achieve a minimum cumulative quality point average of 2.00 (an average of C) for all courses completed before filing the petition.

Upon successful completion of the matriculation process, students will be recognized as degree candidates and have any Advanced Standing Credit previously awarded posted to their transcript.

The Committee on Academic Standing may require a student to take one or more aptitude tests or interest tests if his or her credentials or academic record fail to give evidence of probable academic success. In this case, the student will be notified in writing that arrangements for testing should be made with the University Counseling and Testing Center. A fee is charged for these tests.

Transfer Students and Advanced Standing Credits

Students transferring from community colleges, junior colleges, technical institutes, or other colleges and universities may transfer applicable credits toward the degree requirements of Lincoln College prior to matriculation.

Students admitted with transfer or advanced standing credits from another institution must meet the requirements for admission as set forth under the regulations applicable to regular students. Advanced standing in Lincoln College may be obtained by (1) transfer of credits or (2) proficiency examination.

Transfer of Credits

Subject to the approval of the Academic Standing Committee, credits may be awarded for academic work completed in other approved schools, colleges, or universities if the following criteria are met: (a) the content of the course being submitted is equivalent to that of the corresponding course in Lincoln College; (b) the average grade achieved in the course submitted is "C" or higher; and (c) the remoteness of the time of study does not negate its use as a prerequisite for an advanced course.

Applicants who desire advanced standing credit by transfer should indicate so when they file the application for admission. The applicant should request the Registrar of the institutions of previous attendance to mail an official transcript to the Lincoln College office.

Proficiency Examinations

Applicants who do not meet all the criteria for the normal transfer of credits, but who are able to supply evidence of sufficient knowledge of a subject as a result of previous training or experience, may petition the Academic Standing Committee for the privilege of taking a proficiency examination. If satisfactory proficiency is indicated by the examination, advanced standing credits may be awarded.

Readmission

Former students who seek readmission to continue a program of study after having withdrawn from the college for a period of time may be required to repeat courses which are prerequisites to advanced work.

Registration

Registration for Courses

Completion of admission requirements does not constitute official registration for courses. All students must be properly registered before attending classes. Registrations are processed by the Registrar's office during the official registration periods. Former students should be certain that they have completed prerequisite courses before registration. Students may register for full-year sequences of courses during the official registration periods. They are urged to register as early as possible in order to obtain the desired class schedule.

**Changes in
Registration**

Changes in program should be initiated before the opening day of classes during the official registration periods.

**Official Registration
Periods**

Official registration periods are scheduled before the Fall, Winter, Spring, and Summer Quarters during the academic year. Students are urged to register as early as possible during these periods. Dates of registration periods for each quarter are listed in the 1984–1985 Academic Calendar (see pages ix–xii).

**Courses in Other
Departments of the
University**

Lincoln College students assigned to courses in other departments of the University are charged the tuition rates and other fees effective in the departments in which they are enrolled.



Academic Information

Academic Operations

Campuses and Extensions

All courses are offered at the Huntington Avenue campus, Boston, with some courses available at the Suburban Campus, Burlington, the Dedham campus; Framingham North High School, Framingham; Westwood Senior High School; and at Weymouth High Schools.

The Quarter Calendar

Northeastern University operates on a quarter-system calendar. All courses are evaluated in terms of quarter-hour credit. A quarter-hour credit is equal to three-fourths of a semester-hour credit.

Class Sessions

Classes at Northeastern are scheduled in different modules. In assessing quarter-hour weight for courses, the following statement applies. One quarter hour of credit is equal to approximately fifty minutes of instruction per week, plus two hours of preparation.

Course Work

All the usual methods of instruction are employed—lectures, home assignments, class projects, laboratory work, irregularly scheduled quizzes, and formal examinations. In addition, mid-course examinations are scheduled in most courses and a final examination is required at the completion of all courses. Students are responsible for fulfilling all the requirements of a course. In the event of absence, students must make appropriate arrangements for makeup with the instructor. (See “Makeup Examinations.”)

Student Study Areas

The University Library is well equipped with technical literature. Details about its facilities and hours appear on page 12.

Attendance

Students absent from regularly scheduled sessions in any subject, for whatever reason, may seriously jeopardize their academic progress and status. Students are expected to be in

attendance at all the sessions scheduled in their courses. Excessive absence may be sufficient cause for the Registrar to remove the subject(s) from the student's schedule.

Withdrawal

Simply ceasing to attend classes or notifying the instructor does not constitute official withdrawal from a course. To withdraw officially, the student must notify the Registrar's office or complete the appropriate withdrawal form.

The Registrar will withdraw a student from a course who:

1. Does not attend the first three classes at the beginning of the quarter;
2. Does not attend the first two classes at the beginning of a summer term.

Family Educational Rights and Privacy Act

In accordance with the Family Educational Rights and Privacy Act of 1974, Northeastern University permits its students to inspect their records whenever appropriate and to challenge specific parts of them when they feel it necessary to do so. Specific details of the law as it applies to Northeastern are printed in the *Student Handbook* and are distributed annually during registration periods.

It is the policy of Northeastern University to deal with the student in all academic and administrative matters. If parents require any information regarding the progress of their son or daughter, they may contact the Dean of Students' office.

Academic Standards

The student is required to maintain appropriate levels of academic achievement in terms of grades, quality-point average, and the quantitative credit requirements of his or her program of study to satisfy academic progress criteria and achieve graduation from Lincoln College.

Grading System

The following system of grading is used. The numerical equivalent for each grade is in parentheses.

- | | | |
|----|---------|------------------------|
| A | (4.000) | Outstanding Attainment |
| A- | (3.667) | |
| B+ | (3.333) | |
| B | (3.000) | Good Attainment |
| B- | (2.667) | |
| C+ | (2.333) | |

C	(2.000)	Satisfactory Attainment
C-	(1.667)	
D+	(1.333)	
D	(1.000)	Poor Attainment
D-	(0.667)	
F	(0.000)	Failure
I	—	Incomplete
L	—	Audit (No Credit)
S	—	Satisfactory achievement in a pass-fail course; counts toward total degree requirements
U	—	Unsatisfactory achievement in a pass-fail course
X	—	Incomplete in a pass-fail course
*	—	Grade not received

A general average of "D" is unacceptable and will not allow a student to continue in Lincoln College or to receive a degree from Northeastern University. The "F" grade is a definite failure. The standard procedure for clearing failures in courses offered in Lincoln College is to repeat the course. In some instances circumstances may warrant amending the standard procedure. These circumstances are described in the *Student Handbook* for day students. An "I" or "X" (incomplete) grade is used for a temporary grade to show that the student has not completed the course requirements.

Pass-Fail Courses

Degree Candidates

Any student who is not on academic probation and who has completed forty quarter hours of the required academic work for one of the Lincoln College degree programs may register for one pass-fail course. Thereafter, the student may register for one course on a pass-fail basis for each ten quarter hours of successfully completed work. The maximum pass-fail credit allowed will be nine quarter hours. Written permission from the appropriate academic dean or designee and approval of the instructor must be obtained for each pass-fail course. At no time may a student register for more than one pass-fail course per quarter. Pass-fail courses will be restricted to social science/humanities electives only.

Non-degree Candidates

Students enrolling in Lincoln College courses who are not intending to become degree candidates and who are not on academic probation may register for a course on a pass-fail basis with written permission from the appropriate academic dean or designee and approval of the instructor. At no time may a student register for more than one pass-fail course per quarter.

If the student becomes a degree candidate, only nine quarter hours of social science/humanities elective credit may be used, where applicable.

Auditing Policy

Students are permitted to audit courses upon filing the usual registration forms and paying the regular tuition fees. There is no reduction in fees for auditing. An auditor may participate in class discussion, complete papers and projects, and take tests and examinations for informal evaluation if desired. However, regardless of the amount or quality of work completed, *no academic credit will be granted at any time for courses audited.*

Audit Procedure

The student's decision to take a course on an audit basis must be communicated in writing to the Registrar prior to the fourth class meeting of the course. No exception to this procedure can be approved without authorization by the Academic Standing Committee of the college.

Grade Reports

Grades are mailed to the student by the Registrar and will not be given out at the office of either the Registrar or Lincoln College. Under no circumstances will grades be given over the telephone.

Quality-Point Average

The quality points earned by the student in a given course are determined on the basis of the letter grade achieved and the number of credit hours carried by the course. The total quality points earned, divided by the total number of credit hours, constitutes the quality-point average.

1. When the student has more than one grade in the same course, the most recent grade will be used in the calculation of the quality-point average.
2. A grade of "I" will not be considered in the calculation of the final quality-point average.
3. Although advanced standing credits (ASC) allowed for acceptable work completed at other institutions by transfer students count toward completion of the quantitative credit requirements, neither the credits nor the grades earned in such courses are included in quality-point average computations.
4. In programs made up of combined University College and Lincoln College courses, the cumulative quality-point average will include all work in both colleges.

For example, a student who has registered for thirteen courses, cleared a failure in one of them, cleared an incomplete in an-

other by repeating the course, and received advanced standing credit (ASC) in another, may calculate the quality-point average as follows:

Grade Achieved	Numerical Equivalent	X	Credit Hours	=	Quality Points
A	4.000	X	4	=	16.000
A-	3.667	X	3	=	11.001
B+	3.333	X	3	=	9.999
B	3.000	X	4	=	12.000
B-	2.667	X	2	=	5.334
C+	2.333	X	2	=	4.666
C	2.000	X	4	=	8.000
C-	1.667	X	3	=	5.001
D+	1.333	X	2	=	2.666
D	1.000	X	3	=	3.000
D-	0.667	X	2	=	1.334
F	0.000	X	2	=	0.000
FB	3.000	X	3	=	9.000
I	—	X	—	=	—
IC	2.000	X	2	=	4.000
ASC	—	X	—	=	—
Totals			39		92.001

$$\text{Quality-Point Average} = \frac{\text{Total Quality Points (92.001)}}{\text{Total Credit Hours (39)}} = 2.359$$

The Registrar's office will not be able to recalculate or confirm the calculations of quality-point averages for individual students. Each student's record will be brought up to date before graduation. In the meantime, borderline cases will be checked by the Lincoln College Academic Standing Committee.

Cross-Registration

Day Students Registering for Lincoln College Evening Courses

Basic College students may register for Lincoln College evening courses only to clear deficiencies or to follow a program approved by the appropriate program coordinator. Basic College students may register for evening courses only by completing the registration form available in the Lincoln College office by the end of the first week of the courses. These students must *not* fill out any other evening registration materials. Approval of the program coordinator must be obtained if the course does not appear on the student's approved program sheet. Approval from the Department of Cooperative Education is required if more than one course is to be taken during a co-op term. Upon completion and approval of the registration form, the student is automatically registered for the course. If the course is a substitute for a Basic College course, the latest grade received is considered for quality-point calculations, at which time a College of Engineering petition must be completed to initiate course substitution. Students who do not appear on the evening roster

will not be admitted into the class unless they are in possession of an approved registration form. In all instances, Basic College day students must adhere to the academic and administrative requirements of the Lincoln College evening course.

Evening Students Registering for Basic College Course

Lincoln College evening students who have been enrolled at Northeastern University for one or more quarters are eligible to register for a limited number of Basic College day courses. This policy is designed to accommodate previous Lincoln College students who have experienced employment changes which make it impossible for them to continue in their evening studies. Eligible students may register for eight quarter hours of day course credit per quarter for a maximum of three academic quarters. Since these are part-time evening students in Basic College courses, tuition, fees, student services, and space availability will be based on part-time rates and departmental policy. Interested students must first determine if a specific course is to be offered in the University scheduling office, complete the registration form in Lincoln College, and have the form approved in both the Bursar's and Registrar's office. The student will receive a registration packet to be submitted to the instructor of the course. At this point the academic department will determine the space-available registration priority.

Academic Progress Criteria

It is expected that the student will at all times endeavor to achieve a high record of achievement. The Academic Standing Committee reserves the right to review all students' records and deny readmission to those who fall below a minimum quality level of achievement. This requirement has been established as follows:

In order to be allowed to remain in the college, a student must have achieved a quality-point average of 1.4 at the completion of twenty-four quarter hours; 1.5 at the end of forty-eight quarter hours; and 1.6 at the end of seventy-two quarter hours.

It should be further noted that a student who accumulates the equivalent of six uncleared failures may be considered ineligible to continue the program of study.

Makeup Examinations —Mid-Course

A student absent from a regularly scheduled mid-course examination or quiz may request permission to take a makeup examination. A fee of \$10 must be paid by the student before the instructor generates a special examination. This is a privilege which may be denied if abused by an excessive number of petitions or for other reasons.

Students applying for makeup examinations must request from the instructor permission to take the mid-term examination or quiz and must pay the \$10 fee at the Cashier's office. The instructor will forward the examination to the Lincoln College office for processing.

Makeup mid-term examinations and quizzes will be given on a Saturday at 9 a.m. in a designated room at the Huntington Avenue campus according to the published schedule. Contact the Lincoln College office, 120 Snell Engineering Building (Telephone 437-2500).

Any student who does not take the makeup examination as scheduled will forfeit the makeup privilege.

Makeup Examinations—Finals

A student absent from a final examination will receive a grade of "I" (Incomplete) in the course. He or she may petition for a makeup final examination at the Registrar's office, 120 Hayden Hall.

A student does not automatically have the right to make up a missed final examination. Students must petition for this privilege. If the petition is granted, the student must pay a \$25 fee for taking the special final examination. Petitions may be obtained from the Lincoln College office or in each off-campus Administration office. Petitions for missed finals must be filed in accordance with the published schedule. Contact the Lincoln College office, 120 Snell Engineering Building (Telephone 437-2500).

Students will be notified by mail when and where to take the missed final examination. All examinations will be administered on the Boston campus. Those who do not take makeup final examinations as scheduled forfeit the makeup privilege.

Scholastic Probation

The Academic Standing Committee has the authority to dismiss from the college or place on scholastic probation any student whose scholarship is deficient because of low quality-point average or excessive outstanding failures, regardless of quality-point average.

A student on scholastic probation should be particularly diligent in current course work and make every effort to clear the academic deficiencies as soon as possible. Students whose academic records do not improve or whose failures are not properly cleared may not be allowed to register for further courses.

A student on scholastic probation who has cleared all or a substantial part of any outstanding failures may petition the Academic Standing Committee for removal from the probation list.

Disciplinary Probation

The Academic Standing Committee has the authority to dismiss from the College or place on disciplinary probation any student whom it may deem unworthy because of conduct or character. The committee may ask any student to withdraw from the College who is obviously out of sympathy with its aims and ideals.

Graduation Requirements

To receive the degree of Associate in Engineering, Associate in Science, or Bachelor of Engineering Technology, the student must:

1. Have been formally accepted into "degree candidate" status by the Committee on Admissions;
2. Have completed all the courses of the particular curriculum, either by attendance at Lincoln College or by receiving advanced standing credit;
3. Have completed associate degree programs in eight years and bachelor's programs in twelve years from the date of entrance into Lincoln College. (Extensions of time may be granted by the Academic Standing Committee.);
4. Have been in attendance for at least a year preceding the expected graduation date; and have completed at least one-fourth of the work in Lincoln College;
5. Have achieved a quality-point average of at least 1.800 in courses taken in the college to be awarded the Associate in Engineering or Associate in Science degree; Have achieved a quality-point average of at least 2.000 in all courses in his or her respective major and at least a 1.800 quality-point average overall for the Bachelor of Engineering Technology degree;
6. Have paid the graduation fee of \$25.

In addition, students:

7. May not earn two associate degrees or two bachelor's degrees in the same field of academic specialization;
8. Must complete a minimum of thirty quarter hours of additional credits to be awarded more than one associate or bachelor's degree;
9. May not be awarded the associate and bachelor's degrees at the same commencement;

Academic and Professional Awards

The academic programs offered by Lincoln College and the teaching, counseling, and professional efforts of the faculty and staff are aimed at motivating the student toward the highest possible levels of academic achievement. To encourage scholarly and professional excellence and to recognize quality achievements, the following awards are made at appropriate times during the academic year:

Honor List and Dean's List Scholars

All matriculated students maintaining honor grade averages—minimum quality average of 3.000 and no grades below C—during a quarter, while carrying a minimum of eight quarter hours credit, are recognized as Dean's List Scholars. Students who desire certificates attesting to this honor should request them from the Lincoln College office.

Scholastic Achievement Certificates

Upon graduation with an associate degree, scholastic achievement certificates will be awarded to those students who have achieved distinctly superior attainment in the academic work as follows:

- 3.000–3.499 Q.P.A. Scholastic Achievement
- 3.500–3.749 Q.P.A. High Scholastic Achievement
- 3.750–4.000 Q.P.A. Highest Scholastic Achievement

In order to be eligible for a scholastic achievement certificate, the student must earn a minimum of forty-eight quarter hours of credit in Lincoln College.

Graduation with Honor

Upon graduation, honors will be conferred upon students who have achieved distinctly superior academic achievement in a program leading to the baccalaureate degree as follows:

- 3.000–3.499 Q.P.A. Honor
- 3.500–3.749 Q.P.A. High Honor
- 3.750–4.000 Q.P.A. Highest Honor

In order to be eligible for honors, the student must earn a minimum of seventy-two quarter hours credit in Lincoln College and receive a vote of approval from the faculty with responsibility for the program.

University Awards

The University Awards are presented annually to seniors who have achieved high ranking cumulative academic records. Certificates are awarded at the Annual Class Day ceremony.

Technology Awards

The Technology Awards are presented annually to seniors who have demonstrated superior academic and professional capabilities in their special career fields. Appropriate certificates are distributed to outstanding students enrolled in the following program categories:

Civil Engineering Technology
Electrical Engineering Technology
Mechanical Engineering Technology
Computer Technology

Class Marshal Award

The Class Marshal Award is presented annually at the Class Day Ceremony for graduates to the top-ranking senior in a baccalaureate program. The award consists of an appropriate certificate and the President's Letter of Commendation.

Sigma Epsilon Rho Awards

Sigma Epsilon Rho, the evening colleges' scholastic honor fraternity, annually awards plaques and scholarships for outstanding scholastic achievement to the highest ranking students in University and Lincoln Colleges at the end of their junior year.

Sigma Epsilon Rho Honor Society Scholarship Award

The Sigma Epsilon Rho Honor Society Scholarship Award, established in 1974 by the membership of the Society, is awarded annually to a student of University and/or Lincoln College. Eligible students must have a cumulative quality-point average of 3.0 or better after completing eighty percent or more of their required studies.

Alumni Award for Professional Promise

Established in 1947 by the Northeastern University Alumni Association, the Alumni Award for Professional Promise is presented annually at a final senior class meeting in the spring of the year. The award is made to the senior who has demonstrated unusual professional promise through character traits, scholastic achievement, and work performance.

Leslie B. Cutler Aviation Awards

The Leslie B. Cutler Aviation Awards were established by the members of the Aero Club of New England to honor and give recognition to the late Senator Cutler's service and devotion to the interests of aviation in the Massachusetts General Court,

national legislative bodies, and her private life. These scholarship awards are made to students who most typify the same interest, devotion, and leadership demonstrated by Senator Cutler during her long and distinguished public career.

Mark Caldwell Whitney Memorial Aviation Scholarship Fund

This fund was established in 1981 by the family and friends of the late Mark Caldwell Whitney, an outstanding 1973 graduate of the Aeronautical Technology Program. Income from the fund will be awarded annually to a student with financial need who exemplifies Mr. Whitney's love of flying and commitment to excellence in the aviation field.



Financial Information

Tuition rates, all fees, rules and regulations, courses and course content are subject to revision by the President and the Board of Trustees at any time.

Tuition

Initial Fee

A nonrefundable \$10 registration fee, required of all new students, is due and payable upon registration.

Tuition

Tuition for all part-time evening courses offered for 1984–1985 is \$87 per quarter hour of credit. Tuition for day BET students will be based on the current day-school rate charges for registration and tuition for special courses are at the rate specified for each course. Students are permitted to audit courses; however, there is no reduction in fees for auditing.

Students are not permitted to attend class sessions or take any examination or test until they have paid their tuition fees or have made satisfactory arrangements for payment.

Students will not be advanced in class standing, nor permitted to reenroll in the University, nor have degrees conferred, until all financial obligations to the University have been met.

No certificate of honorable dismissal will be issued to any student who has not fully met his or her financial obligations to the University.

Noncredit courses are charged at quarter-hour rates equal to those of credit courses meeting on an equivalent contact-hour schedule.

Courses in Other University Departments

Students assigned to courses in other departments or colleges of the University are charged the tuition rates and other fees effective in the departments in which they are enrolled.

Day Program Tuition Deposit

Applicants accepted for admission to the day program must upon request pay a nonreturnable tuition deposit of \$100 as evidence of their intention to enroll; this will be applied to their first tuition payment.

Tuition for all courses is charged on a quarter basis and is payable in full at the beginning of each quarter.

Deferred-Payment Privilege

Occasionally situations develop, usually beyond the control of the student, which make it difficult to meet payments in the regular manner. Under such circumstances, the student is advised to discuss the problem personally with the Bursar's office, where a convenient deferred-payment agreement can be worked out. A service fee of \$5 is charged for this privilege.

Late Payment Fee

Payments of tuition are due by Saturday of the week in which the bill is dated. If payment, or a deferred-payment agreement, is not arranged by that date, a late fee of \$50 is charged by the Bursar.

Refund of Tuition

The general policy in all schools and colleges of the University with respect to refunds of tuition to students is as follows:

The University provides all instruction on an academic quarter basis for which students pay at the beginning of each quarter. Tuition refunds will be granted through the first four weeks of a quarter only when specified conditions are met. Questions regarding refunds should be discussed with the Bursar.

Tuition refunds will be granted only on the basis of the date appearing on the official withdrawal application when filed with the Registrar in Room 120 Hayden Hall. Nonattendance does not constitute official withdrawal.

Refunds will be granted in accordance with the following schedule:

<i>Official withdrawal filed within:</i>	<i>Percentage of tuition</i>
1st week of quarter	100%
2nd week of quarter	75%
3rd week of quarter	50%
4th week of quarter	25%

Tuition Underwritten by Employers

An increasing number of companies are underwriting part or all of the cost of tuition of students in their employ. In areas in which payment is made directly by the employer to the University, the student should furnish the Bursar's office a purchase order covering the registration or a statement from an officer of his or her company certifying that the company is underwriting the tuition.

Student Bursar

All inquiries about student accounts should be directed to the Student Account Bursar, 437-2270.

Veterans' Benefits

Veterans' benefits depend on course load and increase sharply when a student's program exceeds eight quarter hours per quarter. Questions and applications should be directed to Room 126 Hayden Hall, Telephone 437-3387.

Special Fees

International Student Fee

New undergraduate international students are charged a \$200 fee, payable, one time only, upon admission to the University.

Student Center Fee

Students attending the Huntington Avenue campus, Boston, in the evening in a part-time program of study will be assessed a Student Center Fee of seventy-five cents per quarter.

Health Service Fee

Students attending the Boston, full-time day cooperative BET programs are required to pay a health service fee of \$300.

Missed Final Examination Fee

Students absent from the regularly scheduled final examination at the end of a course may petition for a "special final examination." The fee for each examination requested by the student is \$30. The fee must be paid when the petition is filed in the Lincoln College office.

Proficiency Examination Fee

Applicants for admission may petition to be awarded advanced standing on the basis of achievement demonstrated by a "proficiency examination." The fee for each examination requested by the applicant is \$35. The fee must be paid when the petition is filed in the Lincoln College office.

Graduation Fee

The University graduation fee, charged to candidates for the associate or bachelor's degree, is \$35 payable on or before May 1 of the year in which the student expects to graduate.

Transcript of Record Fee

Students may request transcripts of their records at the University Registrar's office. There is no charge for the first transcript. After the initial transcript there is a charge of \$2 per copy, payable in advance.

Textbooks and Supplies

Students purchase their own textbooks and work materials. The cost varies according to the subject for which the student is enrolled. The average cost for a normal program of four subjects generally ranges from \$50 to \$100. Textbooks for single courses range from \$10 to \$40.

Students enrolled in Engineering Graphics should be prepared to spend \$25 to \$35 for drawing supplies and \$15 to \$25 for a set of drawing instruments, in addition to the textbooks.

Loan Programs

Full-time students in Lincoln College who are pursuing the BET program should refer to the *Northeastern University Bulletin* for financial aid information.

Financial Aid

The Office of Financial Aid, located in 254 Richards Hall, offers several types of assistance to part-time students. All awards are based on financial need. Aid granted from programs sponsored by the federal government is dependent upon the amount of funding allocated to Northeastern University.

Pell Grants

The Pell Grant Program is a federal aid program designed to provide financial assistance to those who need it to attend post-high school educational institutions. Pell Grants are intended to be the "floor" of a financial aid package and may be combined with other forms of aid in order to meet the full costs of education. The Pell Grant is an award and, unlike a loan, does not have to be repaid. Half-time students taking at least six credit hours each quarter may apply. Awards range up to one-half the maximum allowable by law, contingent upon the total cost of education. Applications are available in the Office of Financial Aid, 254 Richards Hall, or by writing to the Pell Grant Program, Post Office Box 84, Washington, D.C. 20044.

National Direct Student Loan

This program is available to students who are carrying at least one-half the normal academic workload, are accepted as degree candidates, i.e., have sixteen credit hours and a matriculation certificate, and who show evidence of financial need.

Direct Loans are available to students who present evidence of needing financial assistance. Undergraduate students may borrow up to a maximum of \$3,000 for the first two years, or a total of \$6,000 for their entire undergraduate education. Students are allowed a total maximum of \$12,000 through their undergraduate and graduate education. Repayment and interest on Direct Loans are not required until six months after a

student graduates or withdraws from the institution. Repayment of principal may be extended over a ten-year period, with the interest rate of 5 percent per annum. Repayment may be deferred up to a total of three years if the student is pursuing at least a half-time course of study or serving in the Peace Corps, VISTA, or the armed forces.

Community Sources

Students and their families are urged to explore community, industrial, and foundation sources for collegiate financial aid. Parental employers or the appropriate union organization may be a source. In addition, local, civic, political, religious, or educational leaders are often aware of aid sources in the immediate community. Some typical sources may include: P.T.A., Kiwanis, Lions, Elks, Knights of Columbus, Masons, Sons of Italy, Rotary, State Rehabilitation, American Legion, and similar groups or organizations.

University Grants

Each year Northeastern University grants a substantial number of full and partial tuition grants to students who have demonstrated both above-average scholastic achievement and financial need. All applications for aid are automatically considered for all grants administered by the University. It is not necessary for an applicant to specify the grant in which he or she is interested.

Veterans' Benefits

Any veteran covered by the Veterans Readjustment Act of 1966, Public Law 89-358, should report to Room 126 Hayden Hall to fill out the proper enrollment forms. These forms will be made available during registration periods for all students in the Law Enforcement programs at special off-campus locations.

Students needing additional information as to eligibility, allowances, or other details are urged to contact their local office of the Veterans Administration as early as possible.

Guaranteed Student Loan Program

Under this program, students who are matriculated degree candidates, enrolled for at least one-half the normal academic work load, may borrow from a participating bank or other financial institution. Terms and conditions vary from state to state, but a student generally may borrow up to \$2,000 a year (the law allows a maximum of \$2,500 per year) depending on financial need. The federal government pays the interest while the student is in school if the student is eligible for interest subsidy.

Applications for this loan are available from local banks or the education office of your state government. Additional information is available from the University Financial Aid office.

Martin Luther King, Jr. Scholarships

These scholarships were established in 1969 in memory of the late Rev. Martin Luther King, Jr. Awards are made as openings occur to adults from minority groups who would otherwise be unable to continue their education. Stipends will cover tuition expenses not to exceed six quarter hours in any academic quarter (excluding the summer quarter).

H. Patricia Taylor Scholarship Fund

The H. Patricia Taylor Scholarship Fund was established in 1974 by H. Patricia Taylor, a graduate of University College, and her husband, Harry C. Taylor, a graduate of the School of Business. The scholarship expresses their appreciation for financial assistance made available to Mrs. Taylor while obtaining her degree, and is an attempt to provide similar funds to assist others in realizing their potential through higher education. The income from the scholarship fund will be awarded annually to a student enrolled in University College or Lincoln College who demonstrates financial need and academic stability and who meets certain other conditions of eligibility.

Robert G. Keene Memorial Scholarship Fund

This fund was established in 1979 in memory of Robert G. Keene, a graduate of Lincoln College, Class of 1972. The endowment funds were provided by the friends and associates of Robert G. Keene and the Polaroid Corporation, where he served as an engineering manager. The income from the fund will be awarded annually to an undergraduate student in any college of the University who demonstrates financial need as well as strong character and initiative. Primary consideration will be given to children of Polaroid employees.

Student Activities and Alumni Information

Evening Student Council

The Evening Student Council (E.S.C.) was formed to provide a representative body to promote the welfare of the student body in nonacademic areas and to foster extracurricular activities which will enrich University life. It affords participants opportunities to meet and develop close personal relationships with fellow students and administrative staff.

The Evening Student Council provides students with opportunities to develop leadership skills and gives them a chance to discuss matters of professional interest with experts in their chosen field.

The council is made up of interested students in University and Lincoln Colleges, representatives of part-time interest groups, and those specially certified by the council because of their demonstrated interest in the overall adult programs of the University.

The E.S.C., a member of the United States Association of Evening Student Councils, meets evenings on a monthly basis. Students are welcome to visit, observe, and express opinions concerning evening student life.

Social and Professional Clubs

Student activities for part-time students are planned, organized, and operated by the student body with the assistance of the director of University-Lincoln College Student Activities. The programs are designed to keep pace with the changing needs of adult students and to provide maximum opportunity for student participation. All part-time students in University College and Lincoln College are welcome to participate.

The program is flexible in nature and pioneering in spirit to meet the needs of adult students. The office of University-Lincoln College Student Activities is particularly interested in developing new clubs which will benefit students professionally and educationally. If students wish to start clubs related to their professions, this office will help them plan and organize on the local and national levels. The program is dedicated to assisting the adult student in the development of his or her fullest potential. The University-Lincoln College Student Activities office is located in 102 Churchill Hall.

Use of Gymnasium Facilities

Specific schedules for use of the pool, weight-training room, indoor athletic field and track, gymnasium, and wrestling room are set up each quarter for use by all part-time students. In order to become eligible, students must obtain a temporary gymnasium pass each time they wish to use the Cabot Gymnasium complex. Passes are available in Cabot, Room 111, Monday through Friday from 4:30 p.m. to 9:30 p.m., and on Saturday and Sunday during all open hours. All students requesting a pass must present their student identification card. Students using the Cabot Gymnasium complex are required to abide by all the rules of the gym and may be asked to complete a medical release form. Revised schedules for holiday periods will be posted.

Alpha Eta Rho

The Nu Epsilon Chapter of this international aviation fraternity is a social organization open to all aeronautical technology students. It is organized to actively associate the interested students of aviation with leaders and executives in the industry. This close association, strengthened through the bonds of an international aviation fraternity, establishes opportunities for members in their relation to aviation and inspires interest and cooperation among those in the profession who are also members of Alpha Eta Rho.

Alumni Association

More than 90,000 alumni are united within the Alumni Association, created to establish a mutually beneficial relationship between Northeastern and its graduates. The Association is governed by an Executive Committee elected from the alumni community. Membership in the Association is automatic upon graduation.

The Association is headquartered in the Office of Alumni Relations in 125 Richards Hall; telephone 617-437-3186. The official records and addresses of alumni are maintained in the Office of Alumni Records; telephone 617-437-2792.

Activities of the Association include the Homecoming celebration, presentation of the Outstanding Alumni Awards, and the annual presentation of Professional Promise Awards to outstanding seniors in each of the colleges. Alumni officers, in conjunction with the Office of Alumni Relations, have established a series of enrichment/education programs to meet the contemporary vocational and avocational needs of Northeastern's graduates. The Alumni Association has also initiated a successful group travel program to provide the alumni of Northeastern with interesting and economical opportunities for foreign travel, and sponsors group term life insurance for mem-

bers of the alumni community. Notice of all activities is provided in the *Northeastern Alumni Magazine* and in special publications.

Regional alumni clubs have been established from coast to coast. All alumni are eligible to become members of these organizations. The clubs meet periodically with varied programs, often in conjunction with professional and athletic events, faculty visits, and service projects. Additionally, alumni class organizations conduct reunions for their respective classes every five years, and Golden Graduates' Day, for senior alumni, has become an annual event.

The Association sponsors and assists constituent organizations that focus on common professional and avocational interests and college affiliations. These groups have their own officers and conduct various programs throughout the year.

Regional alumni clubs provide a valuable service to the University by sponsoring admissions conferences for high school students and the parents of students who are interested in attending college. In addition, alumni volunteers in many metropolitan areas across the nation represent the Admissions Office on a continuing basis at high schools and community colleges.

One of the most recent developments in alumni activities is the organization of seminars, which are conducted by the association in cooperation with the University's Center for Continuing Education. The seminars are designed particularly for alumni who have a special interest in current events and the field of adult education.

The Northeastern University Alumni Association is a member of the American Alumni Council, a professional organization composed of representatives of all major colleges and universities in the United States and Canada.

Alumni Relations

The Alumni Association is providing a uniquely valuable service to both the University and the community by sponsoring admissions conferences for parents of high school students who are interested in attending college. These meetings, held in cooperation with the Northeastern Department of Admissions, have been extremely well attended. Local residents as well as alumni of the University have been invited to these conferences, which help to clarify many of the questions today's parents and young people have concerning application procedures of colleges and universities.

Placement Service

Many requests from employers are received by the college for men and women of potential ability to fill important positions

of responsibility. It is the policy of the college to serve the students whenever possible by placing them in those positions which promise attractive opportunities for development and advancement. The college cannot guarantee to place its students, but it does endeavor to keep in close touch with those who desire placement service and to assist them in obtaining satisfactory advancement in position and income. No charge is made for placement service. Those needing this assistance should arrange an appointment with the director of placement.

While the college cannot guarantee positions to its graduates, the number of requests usually exceeds the number available in the graduating class of any given year. The policy of the college is to find the best qualified men and women among its graduates for the position which the college is called upon to fill.

The college, in recommending a graduate for a position, furnishes the prospective employer with the facts as to the graduate's ability, character, attitudes, habits, and other qualifications for the position as revealed by the college records. In the last analysis, however, placement in a position depends largely upon the graduate's ability to sell his or her services to the prospective employer. Most employers prefer to consider two or more candidates for a position and generally ask the college to suggest more than one person. Many manufacturing and commercial firms throughout New England call upon the college to assist them in filling important executive and managerial positions.

Academic Programs of Instruction

Scope of Programming

Lincoln College, either by itself or in collaboration with University College, conducts educational programs at the undergraduate level in the following areas of technology:

Pre-Technology Preparation

Civil Engineering

Architectural Engineering Technology

Environmental Engineering Technology

Structural Engineering Technology

Surveying and Highway Engineering Technology

Civil Engineering Technology

Electrical Engineering Technology

Mechanical Engineering Technology

Aerospace Maintenance Engineering Technology

Interdisciplinary Engineering and Science Technology

Telecommunications

Computer Technology

Mechanical-Structural Engineering Technology

Program Selection

Students should be sure that the program they desire is offered in a suitable time period. Most programs are offered in the evening on a part-time basis.

In the fields of electrical engineering technology and mechanical engineering technology, full-time day cooperative programs were established in the fall of 1971. The Aerospace Maintenance Engineering Technology was established as a full-time day transfer cooperative program in the fall of 1983. Students may enter as freshmen or transfer with advanced standing by applying to the Office of Admissions, Northeastern University, 150 Richards Hall.

Degrees and Certificates

Lincoln College conducts education programs on the undergraduate level in various technological areas leading to the following degrees and certificates:

1. Associate in Science degree (AS) requiring 96 to 105 quarter hours of credit;
2. Associate in Engineering degree (AE) requiring 96 to 103 quarter hours of credit;
3. Bachelor of Engineering Technology degree (BET) requiring 180 to 183 quarter hours of credit.

Most courses are available for special students.

Opportunities for Associate Degree Graduates

Graduates of the engineering or science technology programs in Lincoln College, or other similar colleges and institutions, who have earned the associate in engineering or the associate in science degree, may transfer applicable credits toward the degree requirements in the baccalaureate programs in engineering technology, medical technology, or industrial technology.

Those who have maintained a quality-point average of 2.75 or higher in the associate degree programs may apply for transfer to either of the following College of Engineering curricula: (1) day college cooperative education programs in civil, mechanical, electrical, or industrial engineering with credit for up to two years of the five-year program; or (2) the part-time evening programs in civil, electrical, or mechanical engineering with credit for the first three years of the eight-year programs.

PRE-TECHNOLOGY PREPARATION (Noncredit)

Beginning students who have been away from formal study for some time are frequently concerned about their study habits and their verbal, mathematical, and scientific backgrounds. Applicants who anticipate some problems should give serious consideration to enrolling in the introductory courses, the Reading Improvement program, or doing review work through programmed instruction at the Learning Center.

Introductory Courses

These courses offer the student the opportunity to develop background for basic courses in the degree programs and thus increase the probability of successful achievement in advanced technology courses.

Introductory Mathematics I and II

A two-quarter review of high school algebra and some plane geometry designed to prepare students for the course MTH 4107 College Algebra and Trigonometry I. These courses are required of students who do not demonstrate sufficient algebra proficiency on the mathematics placement test. (See course descriptions for MTH 4081 and MTH 4082, page 117.)

Introductory Physics I and II

A two-quarter, relatively nonmathematical introduction to the concepts of physics designed to allow students to prepare themselves for the courses PHY 4117 Physics I or PHY 4104 General Physics I. (See course descriptions for PHY 4081 and PHY 4082 page 119.)

English for International Students I, II, III

A three-quarter, noncredit sequence for foreign-speaking students covering introduction to English grammar, with emphasis on listening, speaking, and writing; selected readings and exercises to strengthen vocabulary and pronunciation; preparation of written and oral reports, business and social correspondence; and advanced work in written and spoken English preparatory to entering ENG 4110 English I.

Reading Improvement

The ability to read well is one of the most important basic tools for the successful completion of a college program. The University's Center for Reading Improvement gives the student an op-

portunity to develop good reading habits in preparation for the intensive reading assignments of college-level courses. The following core skills are covered: previewing, locating main ideas and related details, using guide words and phrases, identifying structural patterns, outlining and summarizing, note-taking, vocabulary building, skimming and scanning, speed-reading, and critical reading. Further information may be obtained at the Center for Reading Improvement.

Programmed Study

Students may enroll in noncredit, self-study courses to better prepare themselves for college academic work and strengthen their high school background at the University's Learning Center, 406 Dodge, Tel. 437-2465.

Courses which may be useful to students in the Lincoln College programs in technology are: slide rule, trigonometry, effective listening, spelling, algebra, study skills, calculus, and English.

University Learning Center hours:

Monday, Tuesday, Wednesday, Thursday—8:00 a.m.–8:00 p.m. (Thursday—closed 12:50 p.m.–1:50 p.m.)
Friday—8:00 a.m.–7:00 p.m.
Saturday, Sunday—1:00 p.m.–5:00 p.m.

CIVIL ENGINEERING TECHNOLOGY PROGRAMS

Civil engineering deals with the planning and construction of all kinds of relatively permanent structures and public works. Its major functions are: the preparation of surveys (topographical, geological, traffic, utility, etc.); the design of structures (buildings, bridges, dams, harbor facilities, etc.); the planning of municipal systems (water, sanitary, gas, flood control, air pollution control, etc.); and the development of transportation facilities (highway, railway, waterway, airway, etc.).

In performing these functions, the civil engineer usually works in close association with professionals in the field and may develop technologically to function independently and in positions of managerial responsibility.

Employment opportunities for Civil Engineering Technology program graduates are with town, city, state, or federal public works departments and agencies; private consulting, engineering, architectural, and construction organizations; and with railroads and the military. Job opportunities will also depend upon the economy and the abilities of the individual.

The Civil Engineering Technology program and related programs offered by Lincoln College are:

Associate in Engineering Degree

page 58	Architectural Engineering Technology
page 59	Environmental Engineering Technology
page 60	Structural Engineering Technology
page 61	Surveying and Highway Engineering Technology

Bachelor of Engineering Technology Degree

page 62	Civil Engineering Technology
page 84	Mechanical-Structural Engineering Technology

Architectural Engineering Technology

Major Code 025

Leading to the Degree of Associate in Engineering

The program in Architectural Engineering Technology offers students the opportunity to prepare to assume responsibilities in the planning, design, and construction of buildings. Employment opportunities are with architectural groups, consulting engineering firms, and government agencies. Job opportunities will also depend upon the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4011), a 3 q.h. course designed to upgrade the student's background.

Fall Course Number	Winter	Spring		Q.H.
MTH 4107			First Year	
			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GET 4170	GET 4171		Engineering Graphics I, II	8
		GET 4100	Computer Programming for Eng. Tech.	4
			Second Year	
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
	ENG 4110		English I	3
		GET 4306	Technical Communications I	3
MTH 4121			Calculus A	4
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
			Third Year	
CHM 4111			General Chemistry I*	3
	ENG 4111		English II	3
		CET 4321	Introduction to Structural Design	4
MET 4301			Mechanics A	4
	MET 4303	MET 4315	Stress Analysis A, B	8
ECN 4115	ECN 4116		Economics Principles and Problems I, II	6
			Fourth Year	
CET 4324			Structural Analysis I	4
	CET 4391	CET 4392	Architectural Design I, II	8
CET 4390			Technology of Modern Architecture	4
	CET 4371		Concrete Design I	4
		CET 4331	Steel Design I	4
			Total AE Degree	102

Note: Associate degree graduates may transfer applicable credits toward the requirements in other Lincoln College programs leading to the Associate in Engineering, Associate in Science, or Bachelor of Engineering Technology Degree.

*Laboratory CHM 4117 required, See *University College Bulletin*.

Environmental Engineering Technology

Major Code 011

Leading to the Degree of Associate in Engineering

The program in Environmental Technology offers the student the opportunity to prepare to assume responsibilities related to the design, construction, operation, and supervision of municipal plants and systems concerned with the storage and distribution of water, and also the disposal of sewage and waste in urban areas with strong considerations regarding contamination and pollution. Employment opportunities are with town, city, and state public works departments, private engineering consultants, architects, contractors, and many other engineering organizations. Job opportunities will also depend upon the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 4107			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GET 4170	GET 4171		Engineering Graphics I, II	8
		GET 4100	Computer Programming for Eng. Tech.	4
Second Year				
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
	ENG 4110		English I	3
		GET 4306	Technical Communications I	3
MTH 4121			Calculus A	4
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
Third Year				
CHM 4111			General Chemistry I*	3
	ENG 4111		English II	3
		CET 4341	Fluid Mechanics	4
MET 4301			Mechanics A	4
	MET 4314	MET 4315	Stress Analysis A, B	8
ECN 4115	ECN 4116		Economic Principles and Problems I, II	6
Fourth Year				
CET 4324			Structural Analysis I	4
	CET 4350		Environmental Engineering I	4
		CET 4393	Construction Administration	4
CET 4361			Materials and Soil Mechanics	4
	CET 4371		Concrete Design I	4
		CET 4351	Environmental Engineering II	4
Total AE Degree				102

Note: Associate degree graduates may transfer applicable credits toward the requirements in other Lincoln College programs leading to the Associate in Engineering, Associate in Science, or Bachelor of Engineering Technology degree.

*Laboratory CHM 4117 required. See *University College Bulletin*.

Structural Engineering Technology

Major Code 012

Leading to the Degree of Associate in Engineering

The program in Structural Engineering Technology offers the student the opportunity to prepare to assume responsibilities related to the planning, design, and supervision of the construction of buildings, bridges, foundations, flood-control projects, and all fixed structures. Employment opportunities are with consulting engineering firms, architectural groups, contractors, railroads, government agencies, the military, and other design-related companies. Job opportunities will also depend upon the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 4107			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GET 4170	GET 4171		Engineering Graphics I, II	8
		GET 4100	Computer Programming for Eng. Tech.	4
Second Year				
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
	ENG 4110		English I	3
		GET 4306	Technical Communications I	3
MTH 4121			Calculus A	4
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
Third Year				
CHM 4111			General Chemistry I*	3
	ENG 4111		English II	3
		CET 4321	Introduction to Structural Design	4
MET 4301			Mechanics A	4
	MET 4314	MET 4315	Stress Analysis A, B	8
ECN 4115	ECN 4116		Economic Principles and Problems I, II	6
Fourth Year				
CET 4324	CET 4325		Structural Analysis I, II	8
		CET 4393	Construction Administration	4
CET 4361			Materials and Soil Mechanics	4
	CET 4371		Concrete Design I	4
		CET 4331	Steel Design I	4
Total AE Degree				102

Note: Associate degree graduates may transfer applicable credits toward the requirements in other Lincoln College programs leading to the Associate in Engineering, Associate in Science, or Bachelor of Engineering Technology degree.

*Laboratory CHM 4117 required. See *University College Bulletin*.

Surveying and Highway Engineering Technology *Major Code 013*

Leading to the Degree of Associate in Engineering

The program in Surveying and Highway Engineering Technology offers the student the opportunity to prepare to assume responsibilities related to the preparation and calculation of preliminary and legal surveys required for both small projects, such as subdivision work, individual lot layouts, and highway layouts, as well as more complex projects relating to sewer systems, pipelines, power transmission lines, dams, reservoirs, and aqueducts. Employment opportunities are with independent surveying companies, civil engineering companies, highway, transit, and railroad planning groups as well as cartographers, construction companies, and contractors. Job opportunities will also depend on the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II (courses MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall	Winter	Spring		Q.H.
Course Number			First Year	
MTH 4107			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GET 4170	GET 4171		Engineering Graphics I, II	8
		GET 4100	Computer Programming for Eng. Tech.	4
Second Year				
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
	ENG 4110		English I	3
		GET 4306	Technical Communications I	3
MTH 4121			Calculus A	4
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
Third Year				
CHM 4111			General Chemistry I*	3
	ENG 4111		English II	3
		CET 4341	Fluid Mechanics	4
MET 4301			Mechanics A	4
	MET 4314	MET 4315	Stress Analysis A, B	8
ECN 4115	ECN 4116		Economic Principles and Problems I, II	6
Fourth Year				
CET 4301			Plane Surveying	4
	CET 4302		Geodetic Surveying	4
		CET 4311	Highway Engineering	4
CET 4307			Legal Aspects of Surveying	4
	CET 4316		Land Use Planning	4
		CET 4303	Route Surveying	4
Total AE Degree				102

Note: Associate degree graduates may transfer applicable credits toward the requirements in other Lincoln College programs leading to the Associate in Engineering, Associate in Science, or Bachelor of Engineering Technology degree.

*Laboratory CHM 4117 required. See *University College Bulletin*.

Civil Engineering Technology

Major Code 014

(Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology)

Leading to the Degree of Bachelor of Engineering Technology

The program in Civil Engineering Technology offers the student the opportunity to prepare to assume broad responsibilities related to surveys required to develop initial design criteria and specifications, and to become involved in the planning, design, and construction of all kinds of relatively permanent structures, municipal plants and systems, or transportation systems and facilities. Employment opportunities are in private consulting firms, construction companies, and public works agencies. Work involving surveying, design, and supervision is open to graduates. Job opportunities will also depend on the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall Course Number	Winter	Spring		Q.H.
MTH 4107			First Year	
			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GET 4170	GET 4171		Engineering Graphics I, II	8
		GET 4100	Computer Programming for Eng. Tech.	4
			Second Year	
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
	ENG 4110		English I	3
		GET 4306	Technical Communications	3
MTH 4121			Calculus A	4
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
			Third Year	
CHM 4111			General Chemistry I*	3
	ENG 4111		English II	3
		MET 4315	Stress Analysis B	4
MET 4301			Mechanics A	4
	MET 4314		Stress Analysis A	4
		CET 4341	Fluid Mechanics	4
ECN 4115	ECN 4116		Economic Principles and Problems I, II	6
			Fourth Year	
CET 4301			Plane Surveying	4
	CET 4302		Geodetic Surveying	4
		CET 4303	Route Surveying	4
()			Social Science/Humanities Elective**	3
CET 4324	CET 4325		Structural Analysis I, II	8
		CET 4321	Introduction to Structural Design	4
			Fifth Year	
CET 4361			Materials and Soil Mechanics	4
	CET 4350		Environmental Engineering I	4
	CET 4371		Concrete Design I	4
		CET 4372	Concrete Design II	4
()			Social Science/Humanities Elective**	3
()			Social Science/Humanities Elective	3
		CET 4331	Steel Design I	4

*Laboratory CHM 4117 required. See *University College Bulletin*.

**Courses with course designators from PSY to LAN are offered by University College.

				Sixth Year	
CET 4332				Steel Design II	4
	CET 4362			Soil Mechanics and Foundations	4
		CET 4311		Highway Engineering	4
()	()	()		Social Science/Humanities Electives	9
()	()	()		Lab Electives	6
				Seventh Year	
()	()	()		Technical Electives A, B, C	12
()	()	()		Technical Electives A, B, C	12
				Total BET Degree	182

Note:Before registering for any electives, the student should submit a proposed program of elective courses—preferably representing a minor field of concentration consistent with his or her personal career objectives—for approval by the Academic Standing Committee.

Elective courses for which proper preparation exists may be chosen from inside or outside the civil engineering discipline.

Transfer students may petition for elective credits for courses that are suitable to the curriculum.

Graduates of the Bachelor of Engineering Technology programs desiring to pursue programs leading to the Bachelor of Science in Engineering degree at Northeastern University may apply through the Admissions Office (150 Richards Hall). Programs in electrical, civil, and mechanical engineering are available on a part-time as well as a regular cooperative program. Industrial, chemical, and engineering programs are available only during the regular day programs.

Candidates must have at least a 2.75 cumulative average and complete a course program prescribed by the major department and the Dean's office.

				Suggested Technical Electives A	
CET 4307				Legal Aspects of Surveying	4
CET 4390				Technology of Modern Architecture	4
CET 4394				Civil Engineering Computer Application	4
IIS 4330				Engineering Economy	4
				Suggested Technical Electives B	
CET 4342				Hydraulics	4
CET 4316				Land Use Planning	4
CET 4391				Architectural Design I	4
				Suggested Technical Electives C	
CET 4351				Environmental Engineering II	4
CET 4393				Construction Administration	4
CET 4392				Architectural Design II	4
				Suggested Laboratory Electives	
CET 4310 (Summers only)				Surveying Lab.	2
CET 4314 CET 4315				Surveying Practice I, II	4
CET 4380				Environmental Lab.	2
CET 4364				Materials and Soil Mechanics Lab	2
MET 4390				Measurement and Analysis Lab.	2
MET 4391				Technology Lab.	2

ELECTRICAL ENGINEERING TECHNOLOGY PROGRAMS

Electrical engineering deals with the design and operation of equipment and systems related to power, communications, data processing, and electrical control. Its major functions are: 1) the generation, transmission, and distribution of electrical energy for light and power purposes; 2) the development and production of equipment for telephone, radio, television, radar, and communication; 3) the design and construction of data processing systems and analog or digital computers; and (4) the application of electrical and electronic devices in the control of processes and manufacture.

Employment opportunities for the Electrical Engineering Technology graduate are in public and private research laboratories, engineering consulting groups with industrial and plant applications, design organizations dealing with operation and manufacture, sales engineering, and the electric utility industry. Job opportunities will depend on the economy and the individual's abilities.

The Electrical Engineering Technology program and related programs offered by Lincoln College are:

page 65	Associate in Engineering Degree Electrical Engineering Technology
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page 66	Bachelor of Engineering Technology Degree Electrical Engineering Technology (Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology)
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The program in Electrical Engineering Technology leading to the Bachelor of Engineering Technology is also offered as a day cooperative program. A specimen curriculum is shown on page 68. For further information please call (617) 437-2200, or write:

Dean of Admissions
Northeastern University
360 Huntington Avenue
Boston, Massachusetts 02115

Electrical Engineering Technology

Major Code 033

Leading to the Degree of Associate in Engineering

The program in Electrical Engineering Technology offers the student the opportunity to prepare to assume responsibilities related to the design, development, and operation of communications, data processing, and electronic control equipment for applications in computers, military and space explorations, and in automated industrial production equipment. Employment opportunities are in communications equipment, electrical manufacturing, data processing and control, equipment organizations, as well as other engineering-oriented companies. Job opportunities will also depend on the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 4107			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GET 4170		GET 4172	Eng. Graphics I, Elect. Eng. Graphics	8
	GET 4100		Computer Programming for Eng. Tech.	4
Second Year				
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
MTH 4121			Calculus A	4
	ENG 4110		English I	3
		GET 4306	Technical Communications I	3
Third Year				
MTH 4122	MTH 4123		Calculus B, C*	8
		MET 4319	Mechanics	4
EET 4151	EET 4152		Circuit Analysis I, II	8
		ENG 4111	English II	3
EET 4124		EET 4125	Circuits Laboratory I, II	4
Fourth Year				
EET 4311	EET 4312	EET 4313	Electronics I, II, III	12
EET 4353	EET 4354		Circuit Analysis III,** IV†	8
		EET 4310	Electrical Measurements	4
		EET 4323	Electronic Laboratory	2
Total AE Degree				103

Note: Associate degree graduates may transfer applicable credits toward the requirements in other Lincoln College programs leading to the Associate in Engineering, Associate in Science, or Bachelor of Engineering Technology degree.

*Social Science/Humanities elective may substitute for MTH 4123.

**EET 4314 may substitute for EET 4353.

†Technical elective may substitute for EET 4354.

Electrical Engineering Technology

Major Code 035

(Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology)

Leading to the Degree of Bachelor of Engineering Technology

The program in Electrical Engineering Technology offers the student the opportunity to prepare to assume broad responsibilities related to the design, development, operating, installation, and production of a wide variety of electrical and electronic equipment concerned with the generation and utilization of electric energy, communications, data processing, and industrial control. Employment opportunities are in public and private research laboratories, engineering consulting firms dealing with industrial and plant applications, electric utilities, electrical and electronic organizations concerned with operation, manufacture, installation, and sales. Job opportunities will also depend on the economy and the student's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 4107			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GET 4170		GET 4172	Eng. Graphics I, Elect. Eng. Graphics	8
	GET 4100		Computer Programming for Eng. Tech.	4
Second Year				
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
MTH 4121			Calculus A	4
	ENG 4110		English I	3
		GET 4306	Technical Communications I	3
MTH 4122	MTH 4123		Calculus B, C	8
		MET 4319	Mechanics	4
EET 4151	EET 4152		Circuit Analysis I, II	8
		ENG 4111	English II	3
EET 4124		EET 4125	Circuits Laboratory I, II	4
Fourth Year				
EET 4311	EET 4312	EET 4313	Electronics I, II, III	12
EET 4353	EET 4354		Circuit Analysis III, IV	8
		EET 4310	Electrical Measurements	4
		EET 4323	Electronics Laboratory	2
Fifth Year				
EET 4314			Pulse & Digital I	4
	EET ()		Technical Elective	4
		EET 4330	Energy Conversion	4
()	()	()	Social Science/Humanities Electives*	9
EET4327	EET 4328		Advanced Electronics Labs. I, II	4
Sixth Year				
EET 4370	EET 4371		Digital Computers I, II	8
		EET 4337	Distributed Systems	4
()	()	()	Social Science/Humanities Electives	9
		EET ()	Technical Elective	4
	EET 4329		Advanced Electronics Lab. III	2

*Courses with course designators from PSY to LAN are offered by University College.

			Seventh Year	
EET ()	EET ()		Technical Electives	8
	EET 4377	EET 4378	Control Engineering I, II	8
()	()	()	Social Science/Humanities Electives	9
			Total BET Degree	180
			Suggested Technical Electives	
MET 4340			Thermodynamics	4
MET 4380			Materials A	4
EET 4330			Microwave Measurements	2
EET 4381	EET 4382	EET 4383	Linear Active Circuit Design I, II, III	6
EET 4391			Basic Optics and Optical Systems Design	4
EET 4392			Optoelectronics and Fiber Optics	4
EET 4315			Pulse & Digital II	4
EET 4317	EET 4318	EET 4319	Principles of Communication Systems I, II, III	12
EET 4362	EET 4363	EET 4364	Basic Power Systems I, II, III	12
IIS 4360			Engineering Economy I	4
IIS 4393			Engineering Probability & Statistics	4
GET 4301			Fortran Engineering Computation	4
CT 4374			Introduction to CPU Hardware	4
CT 4375			CPU Hardware Architecture	4
PHY 4324			Introductory Survey of Lasers	2

Note: Electrical Engineering Technology courses of an elective nature may be chosen from the above list of courses.

Elective courses for which proper preparation exists may be chosen from inside or outside the electrical engineering discipline.

Graduates of the Bachelor of Engineering Technology program desiring to pursue programs leading to the Bachelor of Science in Engineering degree of Northeastern University may apply through the Admissions Office (150 Richards Hall). Programs in electrical, civil, and mechanical engineering are available on a part-time as well as a regular cooperative program. Industrial, chemical, and computer science engineering programs are available only during the regular day programs.

Candidates must have at least a 2.75 cumulative average and complete a course program prescribed by the major department and the Dean's Office.

Before registering for any electives, the student should submit a proposed program of elective courses—preferably representing a minor field of concentration consistent with his or her personal career objectives—for approval by the Academic Standing Committee.

EET 4341, EET 4342, EET 4343 Power & Control Labs. I, II, III may be substituted for EET 4327, EET 4328, EET 4329 Advanced Electronic Labs. I, II, III.

Electrical Engineering Technology (Day Cooperative Curriculum)

(Accredited by the Technology Accreditation Commission of
the Accreditation Board for Engineering and Technology)

Leading to the Degree of Bachelor of Engineering Technology

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 1191	MTH 1192		College Algebra & Trigonometry I, II	8
		MTH 1193	Calculus I	4
PHY 1191	PHY 1192	PHY 1193	Physics I, II, III	12
ENG 1110			Freshman Writing	4
	ENG 1111		Introduction to Literature	4
		ENG 1114	The Literature of Engineering	4
GET 1170		GET 1171	Engineering Graphics I, II	8
	PHY 1194	PHY 1195	Physics Laboratory I, II	4
	GET 1100		Computer Programming for Eng. Tech.	4
Second Year				
MTH 1194	MTH 1195		Calculus A, B	8
EET 1151	EET 1152		Circuit Analysis I, II	8
ECN 1115			Principles of Economics	4
	MET 1319		Mechanics	4
()	()		Social Science/Humanities Electives	8
	EET 1124		Circuits Laboratory I	2
Third Year				
EET 1353	EET 1354		Circuit Analysis III, IV	8
EET 1311	EET 1312		Electronics I, II	8
EET 1360			Engineering Analysis I	4
	EET 1310		Electrical Measurements	4
EET 1125	EET 1323		Circuits Lab. II, Electronics Lab.	4
Fourth Year				
EET 1330			Energy Conversions	4
EET 1313			Electronics III	4
	EET 1314		Pulse & Digital I	4
EET 1327	EET 1328		Advanced Electronics Lab. I, II	4
EET ()	EET ()		Technical Electives	8
()	()		Social Science/Humanities Electives	8
	EET 1337		Distributed Systems	4
Fifth Year				
EET 1377	EET 1378		Control Engineering I, II	8
EET 1370	EET 1371		Digital Computers I, II	8
EET ()	EET ()		Technical Electives	8
EET 1329			Advanced Electronics Lab. III	2
	()		Social Science/Humanities Elective	4
Total BET Degree				180
Suggested Technical Electives				
MET 1340	MET 1341		Thermodynamics A, B	8
MET 1380	MET 1481		Materials A, B	8
EET 1315			Pulse & Digital II	4
EET 1317	EET 1318	EET 1319	Principles of Communication Systems I, II, III	12
EET 1362	EET 1363	EET 1364	Basic Power Systems I, II, III,	12
EET 1390			Optical Measurements	4
EET 1381			Nuclear Technology	4

Note: Students desiring to terminate their program at the end of Quarter 7 may petition to be awarded the Associate in Engineering degree.

Graduates of the day Bachelor of Engineering Technology program who have maintained a superior level of achievement and who wish to continue their academic studies may be qualified to enter the part-time or full-time program leading to the Bachelor of Science in Engineering. For further information, contact the Lincoln College office at 120 Engineering Building, telephone 437-2500.

MECHANICAL ENGINEERING TECHNOLOGY PROGRAMS

Mechanical engineering deals with the harnessing of power resources by means of machinery to perform useful work. In contrast to civil engineering, which deals primarily with static forces and structures, mechanical engineering is more concerned with the motion and kinetics of devices which are activated by hydraulic, electrical, mechanical, or thermodynamic forces. Major functions of the mechanical engineer are: 1) design and installation of all kind of machinery, from pocket watches to the largest of steel boring mills; 2) development and production of engines and transportation equipment (automobile, aircraft, ship, railway, etc.); 3) construction and operation of furnaces, boilers, and heating and air-conditioning equipment for the control of atmospheric and environmental conditions.

Employment opportunities for Mechanical Engineering Technology graduates are in the areas of: 1) research, design, or development; 2) production, operation, testing, or control; 3) installation, maintenance, and sales. In performing these functions, graduates will work in close association with professionals in the field and may develop technologically so as to function independently and in positions of managerial responsibility. Job opportunities will also depend on the economy and the individual's abilities.

The Mechanical Engineering Technology program and related programs offered by Lincoln College are:

	Associate in Engineering Degree
page 71	Mechanical Engineering Technology
	Bachelor of Engineering Technology Degree
page 72	Mechanical Engineering Technology (Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology)
page 74	Mechanical—Structural Technology (Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology)
page 76	Aerospace Maintenance Engineering Technology

The programs in Mechanical Engineering Technology and Aerospace Maintenance Engineering Technology leading to the Bachelor of Engineering Technology are offered as day cooperative programs. Specimen curricula are shown on pages 74 and 76. For further information, please call (617) 437-2200, or write:
Dean of Admissions
Northeastern University
360 Huntington Avenue
Boston, Massachusetts 02115

Mechanical Engineering Technology

Major Code 021

Leading to the Degree of Associate in Engineering

The program in Mechanical Engineering Technology offers the student the opportunity to prepare to assume responsibilities related to the design, production, and installation of mechanical tools, machinery, engines, and transportation equipment in which there is an intermingling of mechanical and hydraulic forces. Because of the increased mechanization of all industry, varied employment opportunities are available in private engineering consultant groups, in light and heavy industries, and in almost all engineering design organizations. Job opportunities will also depend on the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall	Winter	Spring		Q.H.
Course Number			First Year	
MTH 4107			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GET 4170		GET 4171	Engineering Graphics I, II	8
	GET 4100		Computer Programming for Eng. Tech.	4
			Second Year	
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
MTH 4121			Calculus A	4
	ENG 4110		English I	3
		GET 4306	Technical Communications I	3
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
			Third Year	
MTH 4122			Calculus B	4
	GET 4364		Kinematics	4
		MET 4380	Materials A	4
MET 4301	MET 4302		Mechanics A, B	8
		MET 4314	Stress Analysis A	4
			Fourth Year	
MET 4315			Stress Analysis B	4
	MET 4340		Thermodynamics A	4
		MET 4370	Fluid Mechanics A	4
MET 4390			Measurement & Analysis Lab.	2
	MET 4391	MET 4392	Technology Laboratory A, B	4
()			Social Sciences/Humanities Elective*	3
	ENG 4111		English II	3
		ECN 4115	Economic Principles & Problems I	3
			Total AE Degree	101

*Courses with course designators from PSY to LAN are offered by University College.

Mechanical Engineering Technology

Major Code 023

(Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology)

Leading to the Degree of Bachelor of Engineering Technology

The program in Mechanical Engineering Technology offers the student the opportunity to prepare to assume broad responsibilities related to the design, development, production, operation, and installation of all kinds of machinery, engines, and transportation equipment, as well as boilers, furnaces, and heating or air-conditioning equipment which involve interactions of mechanical, hydraulic, and thermodynamic forces. Employment opportunities are in industry producing mechanized and automated equipment, in design and engineering organizations, and in companies dealing primarily with manufacture and production. Job opportunities will also depend on the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements in Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 4107			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GET 4170		GET 4171	Engineering Graphics I, II	8
	GET 4100		Computer Programming for Eng. Tech.	4
Second Year				
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
MTH 4121			Calculus A	4
	ENG 4110		English I	3
		GET 4306	Technical Communications I	3
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
Third Year				
MTH 4122			Calculus B	4
	GET 4364		Kinematics	4
		MET 4380	Materials A	4
MET 4301	MET 4302		Mechanics A, B	8
		MET 4314	Stress Analysis A	4
Fourth Year				
MET 4315			Stress Analysis B	4
	MET 4340		Thermodynamics A	4
		MET 4370	Fluid Mechanics A	4
MET 4390			Measurement & Analysis Lab.	2
	MET 4391	MET 4392	Technology Laboratory A, B	4
()			Social Science/Humanities Elective*	3
	ENG 4111		English II	3
		ECN 4115	Economic Principles & Problems I	3
Fifth Year				
MET 4303			Mechanics C	4
	MET 4341		Thermodynamics B	4
		MET 4342	Refrigeration & Air Conditioning	4
IIS 4360			Engineering Economy	4
	MET 4371		Fluid Mechanics B	4
		MET 4481	Materials B	
		or		
		MET 4416	Stress Analysis C	4

*Courses with course designators from PSY to LAN are offered by University College.

			Sixth Year	
MET 4343			Heat Transfer	4
	MET 4330	MET 4331	Mechanical Design A, B	8
MET 4393	MET 4394	MET 4395	Technology Laboratory C, D, E	6
()	()	()	Social Science/Humanities Electives*	9
			Seventh Year	
()	()	()	Technical Electives	12
()		()	Social Science/Humanities Electives*	6
	EET 4120		Electricity & Electronics	4
()	()		Social Science/Humanities Electives*	6
			Total BET Degree	180
			Suggested Technical Electives	
	CET 4301		Plane Surveying	4
	CET 4331		Steel Design I	4
	CET 4371		Concrete Design	4
	MET 4416		Stress Analysis C	4
	MET 4481		Materials B	4
	MET 4482		Applied Metallurgy	4
	MET 4414		Mechanical Vibrations	4
	MET 4415		Experimental Stress Analysis	4
	MET 4444		Power Generation	4
	EET 4321		Electricity and Electronics II	4
	GET 4301		Fortran Engineering Computation	4

Transfer students may petition for elective credits for courses that are suitable to the curriculum.

Graduates of the Bachelor of Engineering Technology program desiring to pursue programs leading to the Bachelor of Science in Engineering degree at Northeastern University may apply through the Admissions Office (150 Richards Hall). Programs in electrical, civil, and mechanical engineering are available on a part-time as well as a regular day cooperative program. Industrial, chemical, and computer science engineering programs are available only during the regular day programs.

Candidates must have at least a 2.75 cumulative average and complete a course program prescribed by the major department and the Dean's Office.

Before registering for any electives, the student should submit a proposed program of elective courses—preferably representing a minor field of concentration consistent with his or her personal career objectives—for approval by the Academic Standing Committee.

MTH 4123 Calculus C is recommended for all students planning advanced engineering technology subjects.

Note: Associate degree graduates may transfer applicable credits toward the requirements in other Lincoln College programs leading to the Associate in Engineering, Associate in Science, or Bachelor of Engineering Technology degree.

*Courses with course designators from PSY to LAN are offered by University College.

Mechanical Engineering Technology (Day Cooperative Curriculum)

(Accredited by the Technology Accreditation Commission of
the Accreditation Board for Engineering and Technology)

Leading to the Degree of Bachelor of Engineering Technology

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 1191	MTH 1192		College Algebra & Trigonometry I, II	8
		MTH 1193	Calculus I	4
PHY 1191	PHY 1192	PHY 1193	Physics I, II, III	12
ENG 1110			Freshman Writing	4
	PHY 1194	PHY 1195	Physics Labs. I, II	4
GET 1170			Engineering Graphics I	
or				
GET 1100			Computer Programming for Eng. Tech.	4
	ENG 1111		Introduction to Literature	4
		ENG 1114	The Literature of Engineering	4
	GET 1100		Computer Programming for Eng. Tech.	
	or			
	GET 1170		Engineering Graphics I	4
		GET 1171	Engineering Graphics II	4
Second Year				
MTH 1194	MTH 1195		Calculus A, B	8
GET 1364			Kinematics	4
MET 1301			Mechanics A	4
	MET 1302		Mechanics B	4
	MET 1314		Stress Analysis A	4
EET 1320			Electricity & Electronics I	4
	()		Social Science/Humanities Elective	4
Third Year				
MET 1315			Stress Analysis B	4
	MET 1380		Materials A	4
MET 1390			Measurement & Analysis Lab.	2
	MET 1391		Technology Lab. A	2
MET 1340	MET 1341		Thermodynamics A, B	8
MET 1303			Mechanics C	4
	MET 1370		Fluid Mechanics A	4
ECN 1115			Economic Principles & Problems	4
Fourth Year				
MET 1330	MET 1331		Mechanical Design A, B	8
MET 1392	MET 1393		Technology Labs. B, C	4
MET 1371			Fluid Mechanics B	4
	MET 1342		Refrigeration & Air Conditioning	4
MET 1396			Machine Shop (Industrial Engineering Elective on petition with experience)	4
	()		Social Science/Humanities Elective	4
()			Social Science/Humanities Elective	4
Fifth Year				
MET 1394	MET 1395		Technology Labs. D, E	4
IIS 1360			Engineering Economy	4
	MET 1343		Heat Transfer	4
()			Social Science/Humanities Elective	4
	()		Technical Elective	4
()			Technical Elective	4
	()		Social Science/Humanities Elective	4
MET 1481			Materials B	
			or	
MET 1416			Stress Analysis C	4
Total BET Degree				180

Technical Electives Must be Chosen from the Following List:		
MET 1416	Stress Analysis C	4
MET 1415	Exp. Stress Analysis	4
MET 1414	Mech. Vibrations	4
MET 1481	Materials B	4
MET 1482	Applied Metallurgy	4
MET 1444	Power Generation	4
MTH 1123	Differential Equations	4
EET 1321	Electricity & Electronics II	4
EET 1390	Optical Instrumentation	4
CHT 1381	Nuclear Technology	4

Graduates of the day Bachelor of Engineering Technology program who have maintained a superior level of achievement and who wish to continue their academic studies may be qualified to enter the part-time or full-time program leading to the Bachelor of Science in Engineering. For further information contact the Lincoln College office at 120 Engineering Building, telephone 437-2500.

Note: Students desiring to terminate their program at the end of Quarter 7 may petition to be awarded the Associate in Engineering degree.

Aerospace Maintenance Engineering Technology (Day Cooperative Curriculum)

Leading to the degree of Bachelor of Engineering Technology

The Bachelor of Engineering Technology degree is awarded to students who complete the East Coast Aero Technical School airframe and powerplant technical curriculum, or its equivalent, and seven quarters plus three courses at Lincoln College. The required Lincoln College courses are MTH 1191, MTH 1192, MTH 1193 College Algebra and Trigonometry I, II, and Calculus I (12 q.h.). These courses are taken prior to entering into the program.

Fall Course Number	Winter	Spring	First Year	Q.H.
GET 1170			East Coast Aero Technical School (or equiv.)	48
MTH 1194		MTH 1195	Engineering Graphics I	4
PHY 1191	PHY 1192	PHY 1193	Calculus A, B	8
ENG 1110			Physics I, II, III	12
			Freshman Writing	4
	PHY 1194	PHY 1195	Physics Laboratory I, II	4
		GET 1171	Engineering Graphics II	4
	GET 1100		Computer Programming for Eng. Tech.	4
	ENG 1111		Introduction to Literature	4
	()		Social Science/Humanities Elective	4
		ENG 1114	The Literature of Engineering	4
Second Year				
MET 1301	MET 1302		Mechanics A, B	8
EET 1320			Electricity & Electronics I	4
	MET 1314		Stress Analysis A	4
	()		Social Science/Humanities Elective	4
MET 1340			Thermodynamics A	4
	MET 1380		Materials A	4
ECN 1115			Economic Principles and Problems	4
Third Year				
()			Social Science/Humanities Elective	4
MET 1481			Materials B	4
	MET 1370		Fluid Mechanics A	4
	MET 1391		Technology Laboratory A*	4
	or			
	MET 1393		Technology Laboratory C**	2
()			Technical Elective	4
	()		Social Science/Humanities Elective	4
MET 1315			Stress Analysis B*	4
or				
MET 1341			Thermodynamics B**	4
	()		Social Science/Humanities Elective	4
	()		Technical Elective†	4
MET 1390			Measurements Analysis Laboratory	2

*Match MET 1391 Technology Laboratory A with MET 1315 Stress Analysis B.

**Match MET 1393 Technology Laboratory C with MET 1341 Thermodynamics B.

†Suggested technical elective: Same as Mechanical Engineering Technology.

INTERDISCIPLINARY ENGINEERING AND SCIENCE TECHNOLOGY PROGRAMS

These programs offered by Lincoln College present a variety of interdisciplinary combinations of the engineering technology programs. They have been developed to meet the need for technologists in the areas of telecommunications, computer systems, and other technological applications requiring an expertise in several of the academic disciplines.

This demand for multi-skilled technologists reflects the increased reliance of society on the science and engineering technologist to help solve its growth problems. Opportunities are also developing in highly interdisciplinary fields such as ocean engineering, bioengineering, environmental science, and public health.

The programs are designed to offer the student the opportunity to prepare to meet the challenge of interfacing technology and society. The engineering technology student not only learns about related disciplines, but also becomes oriented in the disciplines to which his or her technological skills will be applied.

Interdisciplinary Engineering and Science Technology programs offered to Lincoln College students are:

page 78	Associate in Science Telecommunications
page 79	Associate in Engineering Degree Computer Technology
page 80	Bachelor of Engineering Technology Degree Computer Technology
page 84	Mechanical-Structural Engineering Technology

The program in Computer Technology leading to the Bachelor of Engineering Technology is also offered as a day cooperative program. A specimen curriculum is shown on page 82. For further information please call 437-2200, or write:

Dean of Admissions
Northeastern University
360 Huntington Avenue
Boston, MA 02115

Telecommunications

Major Code 038

Leading to the Degree of Associate in Science

The program in Telecommunications offers students the opportunity to prepare to assume responsibilities relating to the electronic transfer of information through voice, data, or video media using electronic signals in wires, light waves in optic fibers, or radio waves in the earth's atmosphere. Employment opportunities are with telephone, data processing, radio transmission/receiving, cable television, and computer equipment, software, and service industries.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English (ENG 4110) will take a placement exam during class. Some students may be requested to register for Elements of Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall	Winter	Spring		Q.H.
Course Number			First Year	
MTH 4107			College Algebra	4
EET 4180			Intro. to Telecommunications	4
	MTH 4108		Intro. to Calculus	4
	GET 4138		Intro. to Programming for Telecommunications	4
		MTH 4120	Calculus I	4
		GET 4170	Engineering Graphics I	4
			Second Year	
MTH 4121			Calculus A	4
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
	ENG 4110		English I	3
		GET 4306	Technical Communications	3
			Third Year	
EET 4151	EET 4152		Circuit Analysis I, II	8
EET 4384			Video Communications	4
	EET 4124	EET 4125	Circuit Laboratory I, II	4
	ECN 4115		Economic Principles and Problems	3
		EET 4381	Telecommunications Systems I	4
		ENG 4111	English II	3
			Fourth Year	
EET 4311			Electronics I	4
EET 4382	EET 4383		Telecommunications Systems II, III	8
	EET 4312		Electronics II	2
		EET 4310	Electrical Measurements	4
		EET 4323	Electronic Laboratory	4
		MGT 4101	Introduction to Business and Management	3
			Total AS Degree	101

Computer Technology

Major Code 036

Leading to the Degree of Associate in Engineering

The Computer Technology program offers students the opportunity to provide themselves with the mathematical and technological background for understanding both the hardware and software aspects of computer systems, and so will be prepared as: a) programmers who translate engineering, scientific, and business concepts into meaningful form for the computer; b) engineering technicians concerned with the development, specification, production, and operation of computer hardware; and c) applications technicians dealing with the interface of the computer with industrial process and control systems or data acquisition, reduction, and display systems. Job opportunities will also depend on the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 4107			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
CT 4105			Introduction to Programming	4
	GET 4170		Engineering Graphics I	4
		CT 4350	Basic Computer Organization	4
Second Year				
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
MTH 4121			Calculus A	4
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
	ENG 4110		English I	3
		GET 4306	Technical Communications	3
Third Year				
MTH 4122			Calculus B	4
	CT 4310		Fortran	4
	EET 4311		Electronics I	4
EET 4151	EET 4152		Circuit Analysis I, II	8
		ENG 4111	English II	3
		()	Social Science/Humanities Elective*	3
Fourth Year				
CT 4340			Modern Programming Techniques	4
	CT 4345		Assembly Language	4
		CT 4374	Introduction to CPU Hardware	4
CT 4369			Computer Logic	4
		CT 4368	Semiconductor Logic	4
		CT 4320	Cobol	4
Total AE Degree				100

Note: Associate degree graduates may transfer applicable credits toward the requirements in other Lincoln College programs leading to the Associate in Engineering, Associate in Science, or Bachelor of Engineering Technology degree.

*Courses with course designators from PSY to LAN are offered by University College.

Computer Technology

Major Code 037

Leading to the Degree of Bachelor of Engineering Technology

The Computer Technology program offers students the opportunity to prepare themselves to be knowledgeable in both hardware and software. The balance of hardware and software courses combined with hands-on laboratory experience provides the student with the opportunity to develop the skill for interfacing the computer with process plants or machinery. Other employment possibilities exist in programming the computer for engineering, scientific, and business applications; designing, engineering, and testing computers; and interfacing computers with various types of equipment for automated drafting, data collection, and display. Job opportunities will also depend upon the economy and the individual's abilities.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4110), a 3 q.h. course designed to upgrade the student's background.

Fall Course Number	Winter	Spring		
MTH 4107			First Year	
			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
CT 4105			Introduction to Programming	4
	GET 4170		Engineering Graphics I	4
		CT 4350	Basic Computer Organization	4
			Second Year	
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
MTH 4121			Calculus A	4
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
	ENG 4110		English I	3
		GET 4306	Technical Communications I	3
			Third Year	
MTH 4122			Calculus B	4
	CT 4310		Fortran	4
	EET 4311		Electronics I	4
EET 4151	EET 4152		Circuit Analysis I, II	8
		ENG 4111	English II	3
		()	Social Science/Humanities Elective*	3
			Fourth Year	
CT 4340			Modern Programming Techniques	4
	CT 4345		Assembly Language	4
		CT 4374	Introduction to CPU Hardware	4
CT 4369			Computer Logic	4
		CT 4368	Semiconductor Logic	4
		CT 4320	Cobol	4
			Fifth Year	
CT 4375			CPU Hardware Architecture	4
	CT 4351		Advanced Computer Organization	4
		CT()	Computer Technical Elective	4
CT 4330			Non-Numerical Algorithms	4
	()		Social Science/Humanities Elective*	3
		ECN 4115	Economic Principles and Problems	3
	()	()	Social Science/Humanities Electives*	6

*Courses with course designators from PSY to LAN are offered by University College.

			Sixth Year	
CT 4355			Micro-Peripheral Hardware	4
	CT 4335		Numerical Algorithms	4
		CT 4380	Data Communications Methods	4
CT()			Computer Technical Elective	4
	()		Arts and Sciences Elective*	3
		()	Technical Elective	4
	()		Arts and Sciences Elective*	3
			Seventh Year	
CT 4360			Industry Software	4
	CT 4365		Industry Hardware	4
		CT()	Computer Technical Elective	4
CT 4356			Complex Peripheral Hardware	4
	()		Technical Elective	4
		()	Social Science/Humanities Elective*	3
		()	Social Science/Humanities Elective*	3
			Total BET Degree	180
			Computer Technical Electives	
CT 4381			Operating Systems	4
CT 4382			Computer Graphics Programming	4
CT 4383			Data Bases	4
CT 4384			Large System Assembly Languages	4
CT 4385			Introduction to Simulation Programming	4
CT 4386			Development System Hardware	4
CT 4387			Bit Slice Microcomputers	4
CT 4388			Micro Controllers	4
CT 4389			Single Chip Micro Processors	4
CT 4390			Special Problems in Computer Technology	4

All other technical electives may be chosen from other engineering technology or science disciplines within Lincoln or University colleges, subject to the department chairperson's approval.

Graduates of the Bachelor of Engineering Technology program desiring to pursue programs leading to the Bachelor of Science in Engineering degree at Northeastern University may apply through the Admissions Office (150 Richards Hall). Programs in electrical, civil, and mechanical engineering are available on a part-time as well as a regular cooperative program. Industrial, chemical engineering, and computer science programs are available only during the regular day programs.

Candidates must have at least a 2.75 cumulative average and complete a course program prescribed by the major department and the Dean's Office.

*Courses with course designators from PSY to LAN are offered by University College.

Computer Technology (Day Cooperative Curriculum)

Leading to the Degree of Bachelor of Engineering Technology

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 1191	MTH 1192		College Algebra and Trigonometry I, II	8
		MTH 1193	Calculus I	4
PHY 1191	PHY 1192	PHY 1193	Physics I, II, III	12
ENG 1110			Freshman Writing	4
	ENG 1111		Introduction to Literature	4
		ENG 1114	Lit. of Engineering	4
GET 1170			Engineering Graphics I	4
	PHY 1194	PHY 1195	Physics Laboratory I, II	4
	CT 1105		Introduction to Programming	4
		CT 1141	Basic Computer Organization	4

Note: Students desiring to terminate their program at the end of Quarter 7 may petition to be awarded the Associate in Engineering degree.

			Second Year	
MTH 1121	MTH 1122		Calculus A, B	8
EET 1151	EET 1152		Circuit Analysis I, II	8
ECN 1115			Principles of Economics	4
	()		Social Science/Humanities Elective	4
CT 1310			Fortran	4
	()		Social Science/Humanities Elective	4
			Third Year	
EET 1311			Electronics I	4
	CT 1345		Assembly Language	4
CT 1340			Modern Programming Techniques	4
	CT 1374		Introduction to CPU Hardware	4
CT 1369			Computer Logic	4
	CT 1342		Advanced Computer Organization	4
CT 1320			COBOL	4
	CT 1368		Semiconductor Logic	4
			Fourth Year	
CT 1375			CPU Hardware Architecture	4
	CT 1355		Micro-Peripheral Hardware	4
CT 1330			Non-Numerical Algorithms	4
	CT 1335		Numerical Algorithms	4
CT()			Computer Technical Elective	4
	CT 1380		Data Communications Methods	4
()			Social Science/Humanities Elective	4
	CT()		Computer Technical Elective	4
			Fifth Year	
CT()			Computer Technical Elective	4
()	()		Technical Elective I, II	8
CT 1360	CT 1365		Industry Software, Industry Hardware	8
()	()		Social Science/Humanities Elective I, II	8
	GCT 1356		Computer Peripheral Hardware	4
			Total BET Degree	180

	Computer Technical Electives	
CT 1311	Programming with the "C" Language	4
CT 1312	PL/I	4
CT 1313	Basic	4
CT 1381	Operating Systems	4
CT 1382	Computer Graphics Programming	4
CT 1383	Data Bases	4
CT 1384	Large System Assembly Language	4
CT 1385	Introduction to Simulation Programming	4
CT 1386	Development System Hardware	4
CT 1387	Bit Slice Micro Computers	4
CT 1388	Micro Controllers	4
CT 1389	Single Chip Micro Processors	4
CT 1390	Special Problems in Computer Technology	4

All other technical electives may be chosen from other engineering technology or science disciplines within the Basic College, subject to the department chairperson's approval.

Graduates of the day Bachelor of Engineering Technology program who have maintained a superior level of achievement and who wish to continue their academic studies may be qualified to enter the part-time or full-time program leading to the Bachelor of Science in Engineering. For further information, contact the Lincoln College office at 120 Engineering Building, telephone 437-2500.

Mechanical-Structural Engineering Technology

Major Code 015

(Accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology)

Leading to the Degree of Bachelor of Engineering Technology

The program in Mechanical-Structural Engineering Technology is interdisciplinary in that it provides the opportunity for students to prepare themselves to assume responsibilities related to both the planning and construction of relatively static structures such as buildings, bridges, and docks, and also the design and production of dynamic machine tools, machinery, and other mechanical devices. The mechanical and structural content is integrated so as to be complementary and to provide a broad base for design problems of great variety. Employment opportunities lie in the architectural, construction, civil, and mechanical professions and companies.

Prerequisite: Satisfactory completion of the mathematics placement test or the Introductory Mathematics I and II courses (MTH 4081 and MTH 4082). The mathematics placement test must be taken prior to registration.

Each student in English I (ENG 4110) will take a placement examination during class. Some students may be requested to register for Elements of Writing (ENG 4011), a three q.h. course designed to upgrade the student's background.

Fall Course Number	Winter	Spring	First Year	Q.H.
MTH 4107			College Algebra	4
	MTH 4108		Introduction to Calculus	4
		MTH 4120	Calculus I	4
GCT 4170		GCT 4171	Engineering Graphics I, II	8
	GCT 4100		Computer Programming for Eng. Tech.	4
Second Year				
PHY 4117	PHY 4118	PHY 4119	Physics I, II, III	12
MTH 4121			Calculus A	4
	ENG 4110		English I	3
		TCC 4306	Technical Communications I	3
	PHY 4173	PHY 4174	Physics Laboratory I, II	4
Third Year				
MTH 4122			Calculus B	4
MET 4301	MET 4302		Mechanics A, B	8
		MET 4380	Materials A	4
	MET 4314		Stress Analysis A	4
		MET 4370	Fluid Mechanics A	4
Fourth Year				
MET 4315			Stress Analysis B	4
	MET 4371		Fluid Mechanics B	4
		CET 4321	Introduction to Structural Design	4
MET 4390			Measurement & Analysis Lab.	2
	MET 4391	MET 4392	Technology Laboratory A, B	4
()			Social Science/Humanities Elective*	3
	ENG 4111		English II	3
		ECN 4115	Economic Principles & Problems I	3
Fifth Year				
MET 4303			Mechanics C	4
CET 4324	CET 4325		Structural Analysis I, II	8
		CET 4331	Steel Design I	4
	()	()	Technical Electives	8

*Courses with course designators from PSY to LAN are offered by University College.

			Sixth Year	
CET 4332			Steel Design II	4
	CET 4371	CET 4372	Concrete Design I, II	8
()			Social Science/Humanities Elective*	3
	()	()	Technical Electives	8
()	()		Social Science/Humanities Electives*	6
			Seventh Year	
	MET 4330	MET 4331	Mechanical Design A, B	8
()			Technical Elective	4
()		()	Social Science/Humanities Electives*	6
	()		Laboratory Elective	2
()	()		Social Science/Humanities Electives*	6
			Total BET Degree	180
			Suggested Technical Electives	
CET 4301			Plane Surveying	4
CET 4361			Materials & Soil Mechanics	4
CET 4362			Soil Mechanics & Foundations	4
CET 4393			Construction Administration	4
MET 4416			Stress Analysis C	4
MET 4340			Thermodynamics A	4
MET 4481			Materials B	4
MET 4482			Applied Metallurgy	4
MET 4414			Mechanical Vibrations	4
MET 4415			Experimental Stress Analysis	4
IIS 4393			Engineering Probability & Statistics	4
GET 4301			FORTAN Engineering Computation	4

Elective courses for which proper preparation exists may be chosen from inside or outside of the mechanical-structural engineering discipline.

Transfer students may petition for elective credits for courses that are suitable to the curriculum.

Graduates of the Bachelor of Engineering Technology program desiring to pursue programs leading to the Bachelor of Science in Engineering degree at Northeastern University may apply through the Admissions Office (150 Richards Hall). Programs in electrical, civil, and mechanical engineering are available on a part-time as well as a regular cooperative program. Industrial, chemical engineering, and computer science programs are available only during the regular day programs.

Candidates must have at least a 2.75 cumulative average and complete a course program prescribed by the major department and the Dean's Office.

Before registering for any electives, the student should submit a proposed program of elective courses—preferably representing a minor field of concentration consistent with his or her personal career objectives—for approval by the Academic Standing Committee. MTH 4122, MTH 4123 are recommended for all students planning advanced engineering technology subjects.

*Courses with course designators from PSY to LAN are offered by University College.

Description of Courses

On the pages which follow is a numerical and descriptive listing of courses offered in the several curricula of Lincoln College. Although not all courses are offered every year, all will be offered during the normal period of each student's curriculum, except for those special courses as defined in the departmental heading of the following course descriptions. The term "prerequisite" indicates a course that must be taken before undertaking the advanced course to which it applies.

A "quarter hour" equals approximately three clock hours of work (approximately fifty minutes of class and two hours of preparation a week for a quarter of twelve weeks' duration). Laboratory and drawing courses normally require fewer hours of outside preparation and therefore carry less credit than lecture courses.

Abbreviations

prereq.—prerequisite
coreq.—corequisite
cl.—class hours
lab.—laboratory hours
q.h.—quarter hours

Course Number Format

CET 4310

Department
Designator

1 Day Curriculum
4 Evening Curriculum

Course Number

001–099 Compensatory Courses

100–299 Lower Level

(i.e. Freshman and Sophomore Courses)

300–699 Upper Level Courses

Policy on Changes of Program

Lincoln College reserves the right to cancel, modify, or add to the courses in any curriculum.

The University further reserves the right to change the requirements for graduation, tuition, fees charged, and other reg-

ulations. However, no change in tuition and fees at any time shall become effective until the school year following that in which it is announced.

Any changes which may be made from time to time relative to the above policy shall be applicable to all students in the school, college, or department concerned, including former students who may re-enroll.

Index to Courses

<i>Pages</i>	<i>Dept. Designator</i>	
84	CET	Civil Engineering Technology
87	MET	Mechanical Engineering Technology
94	EET	Electrical Engineering Technology
103	CHE	Chemical Engineering Technology
103	IIS	Industrial Engineering Technology
104	CT	Computer Technology
111	GET	General Engineering Technology
113	MTH	Mathematics
115	PHY	Physics

Civil Engineering Technology

CET 4310 Surveying Laboratory (3 lab., 2 q.h.)

An outdoor lab in use of level, transit, and plane table. Level circuits and a transit-tape traverse are run. Topography and layout problems are given.
Prereq. CET 4301.

CET 4314 Surveying Practice I (1 cl., 2 lab., 2 q.h.)

Computing and balancing a control traverse; calculating exact property lines, vertical control survey; plotting from topographic field notes.
Prereq. CET 4303.

CET 4315 Surveying Practice II (1 cl., 2 lab., 2 q.h.)

Scale drawing of the proposed subdivision; calculations required by the land court for the subdivision; street profiles showing grades; drainage study.
Prereq. CET 4314.

CET 4364 Materials and Soil Mechanics Lab. (3 lab., 2 q.h.)

Grain size analysis; specific gravity; CBR optimum moisture; direct shear; seepage and flow nets; consolidation test. *Prereq.* CET 4361.

CET 4301 Plane Surveying (4 cl., 4 q.h.)

Surveying principles; theory of measurements; leveling; traverse computations; area calculation; stadia principles and topography. *Prereq.* MTH 4108.

CET 4302 Geodetic Surveying (2 cl., 4 lab., 4 q.h.)

Introduction to practical astronomy for surveying, including basic spherical trigonometry. Introduction to geodetic surveying, including precise leveling, triangulation, EDM equipment, and base line measurements.

Prereq. CET 4301.

CET 4303 Route Surveying (4 cl., 4 q.h.)

Simple and compound curves; vertical curves; earthwork computations; solution of the mass diagram; introduction to route location by photogrammetry.

Prereq. CET 4301.

CET 4307 Legal Aspects of Surveying (4 cl., 4 q.h.)

Registry of deeds and probate; ownership of land; deeds, descriptions of qualifying expression; adverse possession; Massachusetts land court; expert witness. *Prereq.* CET 4301.

CET 4311 Highway Engineering (4 cl., 4 q.h.)

Engineering considerations in the planning and construction of modern highways and highway routing; traffic flow and traffic control; computer applications to transportation problems. *Prereq.* CET 4301.

CET 4316 Land Use Planning (4 cl., 4 q.h.)

Environmental, sociological, economic aspects, and traditional basis for land use planning. Objectives, content, form and preparation of plan. Community and public facilities, transportation; environmental impact and plan implementation.

Prereq. GCT 4171.

CET 4321 Introduction to Structural Design (2 cl., 4 lab., 4 q.h.)

Tabular methods for the design of members and connections using the AISC Code. *Prereq.* MET 4314, GCT 4171.

CET 4324 Structural Analysis I (4 cl., 4 q.h.)

Reactions, shears, bending moments, and forces developed by loading systems on beams and trusses. Influence lines for beams, girders and trusses; solutions for forces from moving load systems on statically determinate structures.

Prereq. MET 4315.

CET 4325 Structural Analysis II (4 cl., 4 q.h.)

Classical methods of deflection solution for beams and trusses. Methods of solving statically indeterminate structures. *Prereq.* CET 4324.

CET 4331 Steel Design I (4 cl., 4 q.h.)

Design of steel members in structural frames; tension, compression, bending and eccentrically loaded members. Design of plate girders for buildings.

Prereq. CET 4321, MET 4315.

CET 4332 Steel Design II (4 cl., 4 q.h.)

Design of steel for highway bridges, composite design in bridges and buildings, introduction to plastic analysis and design in steel.

Prereq. CET 4331.

CET 4341 Fluid Mechanics (4 cl., 4 q.h.)

Hydrostatics; pressure measurement; hydrostatic forces on submerged areas; simple dams; fluid dynamics; kinematics of flow; continuity, momentum and energy equations; orifices; Pi theorem; laminar and turbulent flow.

Prereq. MET 4314.

CET 4342 Hydraulics (4 cl., 4 q.h.)

Flow in closed conduits; empirical formulas for closed conduit flow; minor losses; compound pipe systems; open channel flow; specific energy and stage relationships; fluid measurement systems; hydraulic machinery.

Prereq. CET 4341.

CET 4350 Environmental I (4 cl., 4 q.h.)

Principles of water supply engineering; population forecasting; quality and quantity of water for various uses. Water treatment processes. Collection and disposal of waste water and storm water; modern treatment methods and waste water plant operation. *Prereq.* CHM 4111 and CET 4341.

CET 4351 Environmental II (2 cl., 4 lab., 4 q.h.)

Layout and design of water treatment and sewage treatment plants. Instrumentation and electrical equipment. Laboratory demonstrations. *Prereq.* CET 4350.

CET 4352 Environmental Lab. (3 lab., 2 q.h.)

Methods and techniques for the physical, chemical, and bacteriological examination of water and waste water, and approaches to treatment through bench scale studies. *Prereq.* CET 4350.

CET 4361 Materials and Soil Mechanics (4 cl., 4 q.h.)

Physical properties of portland cement, aggregates, mixing water and admixtures; batch proportioning; bituminous materials; index properties of soils, soil moisture and structure; compressibility, theory of consolidation. *Prereq.* MET 4315.

CET 4362 Soil Mechanics and Foundations (4 cl., 4 q.h.)

Shear strength of soils, distribution of stress; settlement computations; lateral earth pressures; bearing capacity; soil compaction, soil stabilization, and site investigation. *Prereq.* CET 4361.

CET 4371 Concrete Design I (4 cl., 4 q.h.)

Design of bending members, axially and eccentrically loaded columns by elastic and ultimate strength principles. *Prereq.* MET 4315.

CET 4372 Concrete Design II (4 cl., 4 q.h.)

Reinforced concrete design of basic structures, including considerations of continuity. Introduction to prestressed concrete member design. *Prereq.* CET 4371.

CET 4390 Technology of Modern Architecture (4 cl., 4 q.h.)

General background of architectural styles, both historical and contemporary, with emphasis on engineering design and construction procedures required for the various types of buildings. *Prereq.* None.

CET 4391 Architectural Design I (4 cl., 4 q.h.)

Basic architectural design concepts; proportion, scale form, massing, color texture, and lighting. Orientation of structures; site organization; selection of building materials. *Prereq.* GCT 4371, CET 4390.

CET 4392 Architectural Design II (4 cl., 4 q.h.)

Consideration of the building process. Individual architectural design projects assigned by the instructor. *Prereq.* CET 4391.

CET 4393 Construction Administration (4 cl., 4 q.h.)

Contracts, specifications, and bidding procedures; estimating and scheduling, including critical path; discussion of personnel administration and union negotiation. Bid preparation for a small project. *Prereq.* None.

CET 4394 Civil Engineering Computer Applications (4 cl., 4 q.h.)

An introduction to the systems approach to typical civil engineering problems and their solution using computer applications. *Prereq.* CET 4325, CET 4350, CET 4361, CET 4303.

Mechanical Engineering Technology

MET 1301 Mechanics A (4 cl., 4 q.h., Day Curriculum)

Forces, moments, couples, statics of particles and rigid bodies in two and three dimensions; distributed forces—external and internal; first moments and centroids; analysis of structure—trusses, frames, and machines. *Prereq.* MTH 1193 or MTH 4120, PHY 1191 or PHY 4117.

MET 1302 Mechanics B (4 cl., 4 q.h., Day Curriculum)

Friction, second moments, and virtual work; kinematics of particles—rectilinear and curvilinear motion of dynamic particles—force, mass and acceleration, work and energy. *Prereq.* MET 1301 or MET 4301.

MET 1303 Mechanics C (4 cl., 4 q.h., Day Curriculum)

Impulse and momentum of particles; kinematics and dynamics of rigid bodies—force, mass, and acceleration; dynamics of rigid bodies—work and energy, impulse and momentum; introduction to mechanical vibration. *Prereq.* MET 1302 or MET 4302.

MET 1314 Stress Analysis A (4 cl., 4 q.h., Day Curriculum)

Axially loaded members; stress and strain, allowable stresses, factor of safety, temperature effects, indeterminate members; thin-walled pressure vessels; centric loading of bolted and welded connection. Shear and moment in beams; eccentrically loaded connections; flexural and transverse shearing stresses in beams. *Prereq.* MET 1301 or MET 4301.

MET 1315 Stress Analysis B (4 cl., 4 q.h., Day Curriculum)

Determinate and indeterminate beam deflections and reactions by integration and area moment methods. Torsional stresses and strains; power transmission; eccentric loads on struts, beams, riveted and welded joints; combined stresses; principal stresses; Mohr's circle; theories of failure. *Prereq.* MET 1314 or MET 4314.

MET 1416 Stress Analysis C (4 cl., 4 q.h., Day Curriculum)

Curved beams; nonsymmetrical bending of beams; shear-center and shear stresses on thin sections; composite beams. Columns; energy absorption and resilience; inertial stresses, impact loading; deflection of beams by energy methods. Bolted fastenings. *Prereq.* MET 1315 or MET 4315.

MET 1319 Mechanics (4 cl., 4 q.h., Day Curriculum)

A mechanics course for nonmechanical students. *Prereq.* MTH 1193 or MTH 4120, PHY 1191 or PHY 4117.

MET 1340 Thermodynamics A (4 cl., 4 q.h., Day Curriculum)

General theory of heat and matter; laws of thermodynamics; energy-transformation principles and availability of energy; properties and processes for pure substances and ideal gases. Thermodynamic properties and processes of liquids and vapors; tables and charts; mixtures of fluids; vapor cycles. *Prereq.* PHY 1192 or PHY 4118.

MET 1341 Thermodynamics B (4 cl., 4 q.h., Day Curriculum)

Theory of vapor engines and analysis of types of actual engines using compression of gases and vapors; internal combustion engines. Theory of gas and vapor flow through orifices and nozzles. Design and performance of steam and gas turbines; spark-ignition and compression-ignition engine design and performance. Fan performance. *Prereq.* MET 1340 or MET 4340.

MET 1342 Refrigeration & Air Conditioning (4 cl., 4 q.h., Day Curriculum)

Air-conditioning principles, including psychometrics and heat pumps. Calculation of heating and cooling loads in accordance with A.S.H.R.A.E. practices. Principles of gas compression; analysis of vapor compression; refrigeration systems; low-temperature refrigeration cycles; and absorption refrigeration systems. *Prereq.* MET 1341 or MET 4341.

MET 1343 Heat Transfer (4 cl., 4 q.h., Day Curriculum)

The primary modes of heat transfer; thermal conductivity; thermal conductance/resistance concept; thermal-electrical analogy; combined heat transfer mechanisms, basic equations of conduction; analytical solution of various steady state conduction problems. Dimensional analysis and similarity considerations; natural and forced convection; hydrodynamic and thermal boundary layers; black body radiation; Kirchhoff's law; emissivity and absorptivity; radiation between simple bodies; numerical methods. Log mean temperature differences; overall heat transfer coefficients; heat exchanger effectiveness; tubular exchanger design; regenerative and evaporative heat exchangers; heat transfer engineering problems. *Prereq.* MET 1341 or MET 4341.

MET 1380 Materials A (4 cl., 4 q.h., Day Curriculum)

Lectures on: fundamental metallic structures; general metallurgical information covering theoretical aspects of properties; testing and failure of metals; supplemented by visual aids. Lectures on: alloying and hardening of metals; refinement of metals; equilibrium diagrams; characteristics of engineering metals; principles of metal fabrication. *Prereq.* None.

MET 1381 Materials B (4 cl., 4 q.h., Day Curriculum)

Lectures on: inorganic materials, i.e., polymers, glasses, ceramics, cements, wood, and materials having important electrical and magnetic properties; also a summary of the most up-to-date applications for the fabrication and uses of both metals and nonmetals. Structures of metals; imperfections; phase diagrams; effect of temperature on structure and properties of metals (annealing, recrystallization, recovery, precipitation, diffusion); strengthening mechanisms; mechanical properties of nonferrous metals.

Laboratory: experiments in preparation of samples, selection, polishing, and etching; examination of nonferrous metals; use of the microscope; linear analysis; construction of cooling curves; and simple binary phase diagrams. *Prereq.* MET 1380 or MET 4380.

MET 1482 Applied Metallurgy (4 cl., 4 q.h., Day Curriculum)

Lectures on: mechanical properties of ferrous metals, the iron carbon diagram, high-temperature alloys, hardening methods, impact tests, effects of environment on metals; manufacturing processes; methods of fabrication; limitations on the use of different materials and processes; casting, welding, cutting, drawing, powder metallurgy.

Laboratory: experiments of analysis of stress-strain diagrams of iron and steel, heat treatment of steels, surface corrosion, tempering and drawing, use of metallograph and analysis of the results. Experiments in cold rolling, swaging, drawing of nonferrous metals and the analysis of the results. Tension, shear, fatigue, and machinability tests on ferrous metals. *Prereq.* MET 1481 or MET 4481.

MET 1370 Fluid Mechanics A (4 cl., 4 q.h., Day Curriculum)

Hydrostatics, principles governing fluids at rest; pressure measurement; hydrostatic forces on submerged areas and objects; simple dams; fluids in moving vessels; hoop tension. Fluid flow in pipes under pressure; fluid energy, power and friction loss; Bernoulli's Theorem; flow measurement. *Prereq.* MET 1302 or MET 4302.

MET 1371 Fluid Mechanics B (4 cl., 4 q.h., Day Curriculum)

Pipe networks and reservoir systems; flow in open channels; uniform flow; energy, friction loss, minor losses, velocity distribution, alternate stages of flow, critical flow; nonuniform flow; accelerated and retarded flow; hydraulic jump and waves. *Prereq.* MET 1370 or MET 4370.

MET 1414 Mechanical Vibrations (4 cl., 4 q.h., Day Curriculum)

Elements of vibrating systems, one degree of freedom (undamped free and forced vibration from Newton's law of motion and energy methods); natural frequencies; damped free and forced vibration; impedance and mobility; systems with more than one degree of freedom; influence coefficients, Lagrange's equations, generalized coordinates, vibration absorber. *Prereq.* MET 1303 or MET 1403.

MET 1415 Experimental Stress Analysis (4 cl., 4 q.h., Day Curriculum)

Theory and experimentation showing the application of extensometers and electrical strain gauges and as transducers in the field of experimental stress and strain analysis. Theory and laboratory practice on photoelastic methods as applied to classical model analysis and modern coating analysis. *Prereq.* MET 1315 or MET 4315.

MET 1396 Machine Shop (2 cl., 3 lab., 4 q.h., Day Curriculum)

Introduction to study of machines for metal processing, cutting tools, and fluids; machinability; automatic machinery. *Prereq.* None.

MET 1390 Measurement & Analysis Laboratory (3 lab., 2 q.h., Day Curriculum)

Experimental procedures for the collection and analysis of data by graphical and numerical methods, including computer applications, report writing that draws conclusions which are relative to accuracy, precision, true values, and measured values as they are related to basic mechanical measuring instruments for length, area, volume, specific gravity, pressure, temperature, and time as these parameters are utilized in making mechanical measurements. *Prereq.* MET 1314 or MET 4314, GCT 1100 or GCT 4100, MTH 1122 or MTH 4122, PHY 1119 or PHY 4119.

MET 1391 Technology Laboratory A (3 lab., 2 q.h., Day Curriculum)

Experimental procedures to determine mechanical properties of materials under tensile, compressive, torsional, direct shear, flexural, impact, fatigue, and creep loading conditions as they are affected by environmental conditions that are normal and abnormal; also as they are affected by homogeneity, nonhomogeneity, isotropy, and nonisotropy. *Prereq.* MET 3900 or MET 4390, MET 1315 or MET 4315, MET 1380 or MET 4380, or concurrently.

MET 1392 Technology Laboratory B (3 lab., 2 q.h., Day Curriculum)

Experimental procedures to determine the physical properties of incompressible fluids, measure the flow rates and velocities utilizing pitot tubes, orifice plates, venturii meter, and weirs flow meters, U-tube differential manometers, and piezometers as the fluid flows through open channels, partially filled conduits under pressure, pipe networks, turbines, and pumps. *Prereq.* MET 1390 or MET 4390, MET 1370 or MET 4370, or concurrently.

MET 1393 Technology Laboratory C (3 lab., 2 q.h., Day Curriculum)
Basic thermodynamic relationships; experimental procedures to examine the flow of compressible fluids and steam; examine the energy conversion of a fuel into a working substance and the related heat transfer mechanisms. Operating characteristics of thermal generators, engines, and compressors.
Prereq. Met 1390 or MET 4390, MET 1341 or MET 4341 or concurrently.

MET 1394 Technology Laboratory D (3 lab., 2 q.h., Day Curriculum)
Experimental procedures to examine the operating characteristics and efficiencies of internal combustion engines, brake horsepower, indicated horsepower, friction horsepower, mean effective pressure, fuel consumption, torque, ignition timing, manifold pressure, and compression ratios and internal engines as energy conversion systems; energy conversion of fuels. *Prereq.* MET 1393 or MET 4393, MET 1341 or MET 4341, MET 1343 or MET 4343, or concurrently.

MET 1395 Technology Laboratory E (3 lab., 2 q.h., Day Curriculum)
Experimental procedures of a project nature to examine refrigeration, air conditioning, and heating pump cycles. A project of analytical, design, or experimental nature. Experiments of advanced or specialized nature. *Prereq.* MET 1390 or MET 4390, MET 1342 or MET 4342, MET 1343 or MET 4343.

MET 1444 Power Generation (4 cl., 4 q.h., Day Curriculum)
Basic power generation cycles; gas turbine cycles; effects of combustor temperature, intercooling, etc., on cycle performance; Rankine regenerative cycles; effects of steam temperature, pressure, number of feedwater heaters, etc., upon performance; steam generation equipment; boilers, reactors. Fossil fuel characteristics and effects on boiler design; combustion analysis; draft calculations; axial and centrifugal fan performance characteristics; pump design and performance considerations; heat exchanger design considerations. Applications of principles of economics to cycle and performance considerations; use of load curves; economic considerations of heat rate; economics of equipment selection; study of auxiliary equipment such as precipitators and flue gas desulfurization systems. *Prereq.* MET 1341 or MET 4341.

MET 1330 Mechanical Design A (4 cl., 4 q.h., Day Curriculum)
Introduction to mechanical design, the design process, design factors, creativity, optimization, human factors, value engineering. These principles discussed and developed in an introductory manner through simple design projects. Principles of design, properties, and selection of materials; stress concentrations; strength under combined stresses; theories of failure; impact and fluctuating and repeated loads. *Prereq.* MET 1315 or MET 4315, MET 1380 or MET 4380.

MET 1331 Mechanical Design B (4 cl., 4 q.h., Day Curriculum)
Stresses; deformation and design of fasteners, screws, joints, springs, and bearings; lubrication and journal bearings. Stresses and power transmission of spur, bevel, and worm gear; shaft design; clutches and brakes. *Prereq.* MET 1330 or MET 4330.

MET 1499 Special Problems in Mechanical Engineering Technology (4 q.h., Day Curriculum)
Theoretical or experimental work under individual faculty supervision.
Prereq. Consent of department chairperson.

MET 4301 Mechanics A (4 cl., 4 q.h.)
Forces; moments, couples, statics of particles and rigid bodies in two and three dimensions; distributed forces—external and internal; first moments and centroids; analysis of structure-trusses, frames, and machines. *Prereq.* MTH 1193 or MTH 4120, PHY 1191 or PHY 4117.

MET 4302 Mechanics B (4 cl., 4 q.h.)

Friction, second moments, and virtual work; kinematics of particles—rectilinear and curvilinear motion of dynamic particles—force, mass and acceleration, work and energy. *Prereq.* MET 1301 or MET 4301.

MET 4303 Mechanics C (4 cl., 4 q.h.)

Impulse and momentum of particles; kinematics and dynamics of rigid bodies—force—mass, and acceleration; dynamics of rigid bodies—work and energy. Impulse and momentum; introduction to mechanical vibration. *Prereq.* MET 1302 or MET 4302.

MET 4314 Stress Analysis A (4 cl., 4 q.h.)

Axially loaded members; stress and strain, allowable stresses, factor of safety, temperature effects, indeterminate members; thin-walled pressure vessels; centric loading of bolted and welded connection. Shear and moment in beams; eccentrically loaded connections; flexural and transverse shearing stresses in beams. *Prereq.* MET 1301 or MET 4301.

MET 4315 Stress Analysis B (4 cl., 4 q.h.)

Determinate and indeterminate beam deflections and reactions by integration and area moment methods. Torsional stresses and strains; power transmission; eccentric loads on struts, beams, riveted and welded joints; combined stresses; principal stresses; Mohr's circle theories of failure. *Prereq.* MET 1314 or MET 4314.

MET 4416 Stress Analysis C (4 cl., 4 q.h.)

Curved beams; nonsymmetrical bending of beams; shear-center and shear stresses on thin sections; composite beams. Columns; energy absorption and resilience; inertial stresses, impact loading; deflection of beams by energy methods. Bolted fastenings. *Prereq.* MET 1315 or MET 4315.

MET 4319 Mechanics (4 cl., 4 q.h.)

A mechanics course for nonmechanical students. *Prereq.* MTH 1193 or MTH 4120, PHY 1191 or PHY 4117.

MET 4340 Thermodynamics A (4 cl., 4 q.h.)

General theory of heat and matter; laws of thermodynamics; energy-transformation principles and availability of energy; properties and processes for pure substances and ideal gases. Thermodynamic properties and processes of liquids and vapors; tables and charts; mixtures of fluids; vapor cycles. *Prereq.* PHY 1192 or PHY 4118.

MET 4341 Thermodynamics B (4 cl., 4 q.h.)

Theory of vapor engines and analysis of types of actual engines using compression of gases and vapors; internal combustion engines. Theory of gas and vapor flow through orifices and nozzles. Design and performance of steam and gas turbines; spark-ignition and compression-ignition engine design and performance. Fan performance. *Prereq.* MET 1340 or MET 4340.

MET 4342 Refrigeration & Air Conditioning (4 cl., 4 q.h.)

Air conditioning principles, including psychometrics and heat pumps. Calculation of heating and cooling loads in accordance with A.S.H.R.A.E. practices. Principles of gas compression; analysis of vapor compression; refrigeration systems; low-temperature refrigeration cycles; and absorption refrigeration systems. *Prereq.* MET 1341 or MET 4341.

MET 4343 Heat Transfer (4 cl., 4 q.h.)

The primary modes of heat transfer; thermal conductivity; thermal conductance/resistance concept; thermal-electrical analogy; combined heat transfer mechanisms, basic equations of conduction; analytical solutions of various steady state conduction problems. Dimensional analysis and similarity considerations; natural and forced convection; hydrodynamic and thermal boundary layers; black body radiation; Kirchoff's law; emissivity and absorptivity; radiation between simple bodies; numerical methods. Log mean temperature differences; overall heat transfer coefficients; heat exchanger effectiveness; tubular exchanger design; regenerative and evaporative heat exchangers; heat transfer engineering problems. *Prereq.* MET 1341 or MET 4341.

MET 4380 Materials A (4 cl., 4 q.h.)

Lectures on: fundamental metallic structures; general metallurgical information covering theoretical aspects of properties; testing and failure of metals; supplemented by visual aids. Lectures on: alloying and hardening of metals; refinement of metals; equilibrium diagrams; characteristics of engineering metals; principles of metal fabrication. *Prereq.* None.

MET 4481 Materials B (4 cl., 4 q.h.)

Lectures on: inorganic materials, i.e., polymers, glasses, ceramics, cements, wood, and materials having important electrical and magnetic properties; also a summary of the most up-to-date applications for the fabrication and uses of both metals and nonmetals. Structures of metals; imperfections; phase diagrams; effect of temperature on structure and properties of metals (annealing, recrystallization, recovery, precipitation, diffusion); strengthening mechanisms; mechanical properties of nonferrous metals.

Laboratory: experiments in preparation of samples, selection, polishing, and etching; examination of nonferrous metals; use of the microscope; linear analysis; construction of cooling curves; and simple binary phase diagrams. *Prereq.* MET 1380 or MET 4380.

MET 4482 Applied Metallurgy (4 cl., 4 q.h.)

Lectures on: mechanical properties of ferrous metals, the iron carbon diagram, high-temperature alloys, hardening methods, impact tests, effects of environment on metals; manufacturing processes; methods of fabrication; limitations on the use of different materials and processes; casting, welding, cutting, drawing, powder metallurgy.

Laboratory: experiments on analysis of stress-strain diagrams of iron and steel, heat treatment of steels, surface corrosion, tempering and drawing, use of metallograph and analysis of the results. Experiments in cold rolling, swaging, drawing of nonferrous metals and the analysis of the results. Tension, shear, fatigue, and machinability tests on ferrous metals. *Prereq.* MET 1481 or MET 4481.

MET 4370 Fluid Mechanics A (4 cl., 4 q.h.)

Hydrostatics, principles governing fluids at rest; pressure measurement; hydrostatic forces on submerged areas and objects; simple dams; fluids in moving vessels; hoop tension. Fluid flow in pipes under pressure; fluid energy, power and friction loss; Bernoulli's Theorem; flow measurement. *Prereq.* MET 1302 or MET 4302.

MET 4371 Fluid Mechanics B (4 cl., 4 q.h.)

Pipe networks and reservoir systems; flow in open channels; uniform flow; energy, friction loss, minor losses, velocity distribution, alternate stages of flow, critical flow; nonuniform flow; accelerated and retarded flow; hydraulic jump and waves. *Prereq.* MET 1370 or MET 4370.

MET 4414 Mechanical Vibrations (4 cl., 4 q.h.)

Elements of vibrating systems, one degree of freedom (undamped free and forced vibration from Newton's law of motion and energy methods); natural frequencies; damped free and forced vibration; impedance and mobility, systems with more than one degree of freedom; influence coefficients. Lagrange's equations, generalized coordinates, vibration absorber. *Prereq.* MET 1303 or MET 4303.

MET 4415 Experimental Stress Analysis (4 cl., 4 q.h.)

Theory and experimentation showing the application of extensometers and electrical strain gauges as transducers in the field of experimental stress and strain analysis. Theory and laboratory practice on photoelastic methods as applied to classical model analysis and modern coating analysis. *Prereq.* MET 1315 or MET 4315.

MET 4390 Measurement & Analysis Laboratory (3 lab., 2 q.h.)

Experimental procedures for the collection and analysis of data by graphical and numerical methods, including computer applications, report writing that draws conclusions which are relative to accuracy, precision, true values, and measured values as they are related to basic mechanical measuring instruments for length, area, volume, specific gravity, pressure, temperature, and time as these parameters are utilized in making mechanical measurements. *Prereq.* MET 1314 or MET 4314, GCT 1100 or GCT 4100, MTH 1195 or MTH 4122, PHY 1192 or PHY 4119.

MET 4391 Technology Laboratory A (3 lab., 2 q.h.)

Experimental procedures to determine mechanical properties of materials under tensile, compressive, torsional, direct shear, flexural, impact, fatigue, and creep loading conditions as they are affected by environmental conditions that are normal and abnormal; also as they are affected by homogeneity, nonhomogeneity, isotropy, and nonisotropy. *Prereq.* MET 1390 or MET 4390, MET 1315 or MET 4315, MET 1380 or MET 4380, or concurrently.

MET 4392 Technology Laboratory B (3 lab., 2 q.h.)

Experimental procedures to determine the physical properties of incompressible fluids, measure the flow rates and velocities utilizing pitot tubes, orifice plates, venturii meter, and weirs flow meter, U tube differential manometers, and piezometers as the fluid flows through open channels, partially filled conduits, conduits under pressure, pipe networks, turbines and pumps. *Prereq.* MET 1390 or MET 4390, MET 1370 or MET 4370, or concurrently.

MET 4393 Technology Laboratory C (3 lab., 2 q.h.)

Basic thermodynamic relationships; experimental procedures to examine the flow of compressible fluids and steam; examine the energy conversion of a fuel into a working substance and the related heat transfer mechanisms. Operating characteristics of thermal generators, engines, and compressors. *Prereq.* MET 1390 or MET 4390, MET 1341 or MET 4341, or concurrently.

MET 4394 Technology Laboratory D (3 lab., 2 q.h.)

Experimental procedures to examine the operating characteristics and efficiencies of internal combustion engines, brake horsepower, indicated horsepower, mean effective pressure, fuel consumption, torque, ignition timing, manifold pressure, and compression ratios and internal engines as energy conversion systems; energy conversion of fuels. *Prereq.* MET 1393 or MET 4393, MET 1341 or MET 4341, MET 1343 or MET 4343, or concurrently.

MET 4395 Technology Laboratory E (3 lab., 2 q.h.)

Experimental procedures of a project nature to examine refrigeration, air conditioning, and heating pump cycles. A project of analytical, design, or experimental nature. Experiments of advanced or specialized nature. *Prereq.* MET 1390 or MET 4390, MET 1342 or MET 4342, MET 1343 or MET 4343.

MET 4444 Power Generation (4 cl., 4 q.h.)

Basic power generation cycles; gas turbine cycles; effects of combustor temperature, intercooling, etc., on cycle performance; Rankine regenerative cycles; effects of steam temperature, pressure, number of feedwater heaters, etc., upon performance; steam generation equipment: boilers, reactors. Fossil fuel characteristics and effects on boiler design; combustion analysis; draft calculations; axial and centrifugal fan performance characteristics; pump design and performance considerations; heat exchanger design considerations. Applications of principles of economics to cycle and performance considerations; use of load curves; economic considerations of heat rate; economics of equipment selection; study of auxiliary equipment, such as precipitators and flue gas desulfurization systems. *Prereq.* MET 1341 or MET 4341, MET 4395.

MET 4340 Mechanical Design A (4 cl., 4 q.h.)

Introduction to mechanical design, the design process, design factors, creativity, optimization, human factors, value engineering. These principles discussed and developed in an introductory manner through simple design projects. Principles of design, properties and selection of materials; stress concentrations; strength under combined stresses; theories of failure; impact and fluctuating and repeated loads. *Prereq.* MET 1314 or MET 4314, MET 1380 or MET 4380.

MET 4331 Mechanical Design B (4 cl., 4 q.h.)

Stresses; deformation and design of fasteners, screws, joints, springs, and bearings, lubrication and journal bearings. Stresses and power transmission of spur, bevel, and worm gear; shaft design; clutches and brakes. *Prereq.* MET 1330 or MET 4330.

Electrical Engineering Technology

EET 4341 Power and Controls Laboratory I (2½ lab., 2 q.h.)

These experiments introduce the student to standard laboratory measurement equipment, including voltmeter, ammeters, oscilloscopes, and frequency counters, as well as data-taking methods and report writing. Devices investigated include diodes, bipolar transistors, field effect devices, silicon control rectifiers, unijunction transistor, power supplies, regulators, and various types of feedback transistor amplifiers. *Prereq.* EET 1830 or EET 4330.

EET 4342 Power and Controls Laboratory II (2½ lab., 2 q.h.)

Experiments with characteristics of DC motors and generators, single-and multiple-phase transformers, induction motors, synchronous motors, and 3-phase power measurements. *Prereq.* EET 4341.

EET 4343 Power and Controls Laboratory III (2½ lab., 2 q.h.)

Experiments with self-synchronous devices such as control transformers, transmitters and receivers, AC and DC servomotors, open and closed loop response of servo mechanisms and stepping motors. *Prereq.* EET 4342.

EET 4349 Advanced Electronics Laboratory IV (2½ lab., 2 q.h.)

Electronic engineering exercises selected from the following topics: transistor amplifier design, operational amplifiers, analog computation, Fourier optics, acoustics, and microwaves. *Prereq.* EET 1329 or EET 4329.

EET 4350 Advanced Electronics Laboratory V (2½ lab., 2 q.h.)

Design projects laboratory. Students will be directed in design of such projects as motor speed control, DC-DC converter, high current pulse amplifiers. etc. *Prereq.* EET 4349.

EET 4381 Linear Active Circuit Design I (2 cl., 2 q.h.)

Effects of feedback on impedance levels, frequency response, and distortion. Use of block diagram algebra and computation of transfer functions, frequency response. Stability of feedback circuits, Nyquist, Bode, and Nichols plots. Application of Op-Amp circuits in integrators, differentiators, and active filters. *Prereq.* EET 1313.

EET 4382 Linear Active Circuit Design II (2 cl., 2 q.h.)

Building blocks for multistage amplifiers. Analysis of differential amplifier stages, drifts, offset, CM rejection ratio. High-frequency behavior of transistors. Frequency response of multistage transistor amplifiers. Compensation techniques of feedback amplifiers. *Prereq.* EET 4381.

EET 4383 Linear Active Circuit Design III (2 cl., 2 q.h.)

Applications of Op-Amps. Function generators, comparators, sample and hold D/A, A/D converters, oscillators, phase locked loops. Power amplifiers class A, B, AB, and C. Thermal analysis of power circuits. Switching amplifiers. *Prereq.* EET 4382.

EET 1310 Electrical Measurements (4 cl., 4 q.h., Day Curriculum)

Standards of measurement, dimensional analysis, errors and measurement of dispersed data, discrete and continuous variables, binomial distribution, normal distribution, guaranteed error, methods of resistance measurements, digital voltmeters and analog to digital conversion, voltage references, potentiometers and a.c. bridges. *Prereq.* EET 1353 or EET 4353.

EET 1311 Electronics I (4 cl., 4 q.h., Day Curriculum)

Semiconductor diodes and applications, transistor biasing techniques, graphical analysis of basic amplifiers, d.c. and a.c. load lines. *Prereq.* EET 1152 or EET 4152.

EET 1312 Electronics II (4 cl., 4 q.h., Day Curriculum)

Small-signal, low-frequency transistor models, gains, and impedances at mid-band, frequency effects in transistor circuits, multistage circuits, transistors used as current sources. *Prereq.* EET 1311 or EET 4311.

EET 1313 Electronics III (4 cl., 4 q.h., Day Curriculum)

Review of Bode plots, transistor circuits at low and high frequencies, feedback, operational amplifiers, differential amplifiers, applications. *Prereq.* EET 1312 or EET 4312.

EET 1314 Pulse & Digital I (4 cl., 4 q.h., Day Curriculum)

Switching characteristics of semiconductor devices; wave generation and shaping, using combinations of passive and integrated circuit components; comparators, hysteresis, and the dual ramp analog to digital converter-voltmeter circuits; voltage to frequency conversion. *Prereq.* EET 1311 or EET 4311.

EET 1315 Pulse & Digital II (4 cl., 4 q.h., Day Curriculum)

Digital operations; logic statements and theorems; minimization of logic functions; logic gates and the characteristics of the integrated logic families; flip-flop counters and registers; introduction to sequential circuit design; sample and hold circuits; analog to digital conversion. *Prereq.* EET 1314 or EET 4314.

EET 1317 Principles of Communication Systems I (4 cl., 4 q.h., Day Curriculum)

Signal analysis using Fourier methods; noise in communication systems; frequency selective amplifiers including wideband; transistor power amplifiers AF and RF; oscillators; signal sources and applications. *Prereq.* EET 1313 or EET 4313.

EET 1318 Principles of Communication Systems II (4 cl., 4 q.h., Day Curriculum)

Basic theory of amplitude, frequency, phase and pulse code modulated systems; analysis of modulating and demodulating circuits; carrier systems using SSB; system block and level diagrams; logic control circuits in communication systems; modems. *Prereq.* EET 1317 or EET 4317.

EET 1319 Principles of Communication Systems III (4 cl., 4 q.h., Day Curriculum)

Fundamentals of digital communications; sampling requirements; analog to digital conversion methods; system capacity and bandwidth; comparison of practical digital systems PAM, PCM, PFM, PWM; time and frequency division multiplexing; data decoding; selected examples from telemetry and computer links. *Prereq.* EET 1318 or EET 4318.

EET 1320 Electricity and Electronics I (4 cl., 4 q.h., Day Curriculum)

Introduction to circuit analysis, resistive networks, periodic excitation function, steady state a-c circuits; the physical foundations of electronics and the physical operation of electronic devices. (This course is not open to Electrical Engineering Technology majors.) *Prereq.* MTH 1193 or MTH 4120.

EET 1321 Electricity and Electronics II (4 cl., 4 q.h., Day Curriculum)

Single-stage electronic circuits, magnetic circuits and transformers, electro mechanical energy conversion, d-c machines, a-c machines. (This course is not open to Electrical Engineering Technology majors.) *Prereq.* EET 1320 or EET 4320.

EET 1323 Electronics Laboratory (3 lab., 2 q.h., Day Curriculum)

Experiments dealing with laboratory equipment (meters and oscilloscopes) techniques; junction and field-effect transistor characteristics; vacuum and semiconductor diodes; power supplies, including the regulated type; silicon controlled rectifiers; resistance-coupled amplifiers using transistors, including feedback methods. *Prereq.* EET 1312 or EET 4312, or concurrently.

EET 1324 Circuits Laboratory I (3 lab., 2 q.h., Day Curriculum)

Experimentation in electronic circuit theory utilizing various measurement techniques. Instrumentation verification of circuit theorems; response of circuits to steps and impulses; oscilloscope theory and applications. *Prereq.* EET 1151 or EET 4151.

EET 1325 Circuits Laboratory II (3 lab., 2 q.h., Day Curriculum)

Further experimentation in electrical circuits and measurement techniques. Experiments include response of circuits to steps and impulses, nonlinear devices, terminal characteristics of active devices, log modulus plots, network parameters, and synthesis. Fourier analysis and synthesis. *Prereq.* EET 1324 or EET 4324.

EET 1327 Advanced Electronics Laboratory I (3 lab., 2 q.h., Day Curriculum)
Experiments dealing with the use of oscilloscopes, the examination of transistor audio amplifiers, push-pull amplifiers, drivers, pulse and video amplifiers, transients and wave-shaping circuits, audio frequency oscillators, and the study of operational amplifiers. *Prereq.* EET 1323 or EET 4323.

EET 1328 Advanced Electronics Laboratory II (3 lab., 2 q.h., Day Curriculum)
Experiments dealing with the modulation of a class C amplifier, the diode detector, basic timing circuits, RF and crystal oscillators, astable multivibrators, logic gates, flip-flops, binary adders, registers and counters; active filters, frequency modulation detectors, and analog-to-digital and digital-to-analog conversion. *Prereq.* EET 1327 or EET 4327.

ETT 1329 Advanced Electronics Laboratory III (3 lab., 2 q.h., Day Curriculum)
Spectral studies of FM and PM waves, amplitude limiters; the balanced modulators and single sideband generators; integrated circuit timers and monolithic random access memory; monolithic phase-locked loop as well as a series of microwave experiments and a series of digital experiments. *Prereq.* EET 1328 or EET 4328.

EET 1330 Energy Conversion (4 cl., 4 q.h., Day Curriculum)
Generalized theory of rotating energy conversion devices; steady-state operation of the multiply-excited direct-current machine; control of speed; special machines; transformers; steady-state considerations of induction and synchronous machines; generalized machine and circuit model; Laplace transform techniques applied to the analysis of dynamic operating modes of rotating machines. *Prereq.* EET 1353 or EET 4353.

EET 1337 Distributed Systems (4 cl., 4 q.h., Day Curriculum)
Radiation, transmission, and reception of electromagnetic waves; distributed-line constants and traveling waves of transmission lines; differential equations of the uniform line. *Prereq.* MTH 1195 or MTH 4122.

EET 1151 Circuits Analysis I (4 cl., 4 q.h., Day Curriculum)
Ohm's law, Kirchhoff's current and voltage laws, equivalent resistances and sources, mesh and modal analysis, network theorems, two-port networks and power relations—all with respect to direct currents; energy storage, singularity functions, response of R, L, and C elements to singularities. *Prereq.* MTH 1193 or MTH 4120 and PHY 1193 or PHY 4119.

EET 1152 Circuits Analysis I (4 cl., 4 q.h., Day Curriculum)
Complex algebra, phasors, frequency domain, mutual inductance, transformers, steady-state a-c theory, driving point and transfer impedances, power and energy in a-c circuits; Laplace transforms; partial fraction expansion; Laplace transform techniques applied to the solution of RLC networks. *Prereq.* EET 1151 or EET 4151.

EET 1353 Circuits Analysis III (4 cl., 4 q.h., Day Curriculum)
Application of differential equations to the solutions of linear, time-invariant electrical networks; introduction to singularity functions, convolution, and time domain transient analysis; network topology and duality; introduction to the methods of transformation calculus and complex frequency concepts. *Prereq.* EET 1152 or EET 4152.

EET 1354 Circuits Analysis IV (4 cl., 4 q.h., Day Curriculum)
Signal analysis in the frequency domain; Fourier series; Fourier and Laplace transform methods; a varied selection of circuit problems is solved using Laplace transforms and related theorems. *Prereq.* EET 1353 or EET 4353.

- EET 1360 Engineering Analysis I** (4 cl., 4 q.h., Day Curriculum)
Linear algebra and its application to circuit equations; solution of linear differential equations, including an introduction to Laplace transforms. *Prereq.* MTH 1195 or MTH 4122 and EET 1152 or EET 4152.
- EET 1362 Basic Power Systems I** (4 cl., 4 q.h., Day Curriculum)
Consideration of power transmission lines; line constants; current voltage and power relations; introduction to electric-power distribution loads, feeders, and substations; application of matrices. *Prereq.* EET 1354 or EET 4354, GET 1100 or GET 4100.
- EET 1363 Basic Power Systems II** (4 cl., 4 q.h., Day Curriculum)
Consideration of symmetrical and unsymmetrical faults; protective devices—application and coordination; power flow in electric circuits; steady-state power limitations of systems; voltage regulation theory and application. *Prereq.* EET 1362 or EET 4362.
- EET 1364 Basic Power Systems III** (4 cl., 4 q.h., Day Curriculum)
Computer applications to power systems with emphasis on load-flow studies; basic ideas of systems planning, short-circuit studies and system stability. *Prereq.* EET 1363 or EET 4363.
- EET 1370 Digital Computers** (4 cl., 4 q.h., Day Curriculum)
Introduction to the field of digital computer design. Topics include general computer organization, number systems and number representations, design characteristics of major computer units, Boolean algebra applications to computer design. *Prereq.* EET 1311 or EET 4311.
- EET 1371 Digital Computers II** (4 cl., 4 q.h., Day Curriculum)
Examination of microprocessor architecture and organization. Study of the machine language and assembly coding of an industry-accepted microprocessor. A suitable topic selected from the current literature by the instructor will be analyzed. Assembly language coding problems will be assigned. *Prereq.* EET 1370 or EET 4370.
- EET 1377 Control Engineering I** (4 cl., 4 q.h., Day Curriculum)
Analysis of linear servomechanisms under both transient and steady-state conditions; signal flow graphs; Laplace transforms used in the formulation of block diagrams and transfer function. *Prereq.* EET 1354 or EET 4354 and MTH 1195 or MTH 4122.
- EET 1378 Control Engineering II** (4 cl., 4 q.h., Day Curriculum)
System stability; root locus techniques; treatment of Nyquist criteria and Bode diagram methods for systems evaluation. *Prereq.* EET 1377 or EET 4377.
- EET 1390 Optical Instrumentation** (4 cl., 4 q.h., Day Curriculum)
Telescopes, microscopes, etc., as optical system components. Includes magnification, aberrations, resolution criteria, photometry. Compatibility of system components and optimization of systems. The basic nonimage-forming systems used for analysis control and metrology. *Prereq.* MTH 1192 or MTH 4108 and PHY 1193 or PHY 4119.
- EET 1399 Special Problems in Electrical Engineering Technology** (4 q.h.)
Theoretical or experimental work under individual faculty supervision. *Prereq.* Consent of department chairperson.

EET 4321 Digital Signal Processing 1 (2 cl., 2 q.h.)

Introduction to digital signal processing discussing sampling, transform and discrete Fourier transform. *Prereq.* EET 1354 or EET 4354 and GET 1100 or GET 4100.

EET 4322 Digital Signal Processing 2 (2 cl., 2 q.h.)

Discrete systems are taken up with a comparison of continuous and digital filter design. *Prereq.* EET 4321.

EET 4323 Digital Signal Processing 3 (2 cl., 2 q.h.)

Frequency domain design is covered with linear phase FIR filters, fast Fourier transforms, continuing with convolution and correlation. *Prereq.* EET 4322.

EET 4399 Special Problems in Electrical Engineering Technology (4 q.h.)

Theoretical or experimental work under individual faculty supervision. *Prereq.* Consent of department chairperson.

EET 4310 Electrical Measurements (4 cl., 4 q.h.)

Standards of measurements, dimensional analysis, errors and measurements of dispersed data, discrete and continuous variables, binomial distribution, normal distribution, guaranteed error, methods of resistance measurements, digital voltmeters and analog to digital conversion, voltage references, potentiometers and a.c. bridges. *Prereq.* EET 1353 or EET 4353.

EET 4311 Electronics I (4 cl., 4 q.h.)

Semiconductor diodes and applications, transistor biasing techniques, graphical analysis of basic amplifiers, d.c. and a.c. load lines. *Prereq.* EET 1352 or EET 4352.

EET 4312 Electronics II (4 cl., 4 q.h.)

Small-signal, low-frequency transistor models, gains and impedances at mid-band, frequency effects in transistor circuits, multistage circuits, transistors used as current sources. *Prereq.* EET 1311 or EET 4311.

EET 4313 Electronics III (4 cl., 4 q.h.)

Review of Bode plots, transistor circuits at low and high frequencies, feedback, operational amplifiers, differential amplifiers, applications. *Prereq.* EET 1312 or EET 4312.

EET 4314 Pulse & Digital (4 cl., 4 q.h.)

Switching characteristics of semiconductor devices; wave generation and shaping using combinations of passive and integrated circuit components; comparators, hysteresis, and the dual ramp analog to digital converter-voltmeter circuits; voltage to frequency conversion. *Prereq.* EET 1311 or EET 4311.

EET 4315 Pulse & Digital II (4 cl., 4 q.h.)

Digital operations; logic statements and theorems; minimization of logic functions; logic gates and the characteristics of the integrated logic families; flip-flop counters and registers; introduction to sequential circuit design; sample and hold circuits; analog or digital conversion. *Prereq.* EET 1314 or EET 4314.

EET 4317 Principles of Communication Systems I (4 cl., 4 q.h.)

Signal analysis using Fourier methods; noise in communication systems; frequency selective amplifiers, including wideband; transistor power amplifiers AF and RF; oscillators; signal sources, and applications. *Prereq.* EET 1313 or EET 4313.

EET 4318 Principles of Communication Systems II (4 cl., 4 q.h.)

Basic theory of amplitude, frequency, phase and pulse code modulated systems; analysis of modulating and demodulating circuits; carrier systems using SSB; system block and level diagrams; logic control circuits in communication systems; modems. *Prereq. EET 1317 or EET 4317.*

EET 4319 Principles of Communication Systems III (4 cl., 4 q.h.)

Fundamentals of digital communications; sampling requirements; analog to digital conversion methods; system capacity and bandwidth; comparison of practical digital systems PAM, PCM, PFM, PWM; time and frequency division multiplexing; data decoding; selected examples from telemetry and computer links. *Prereq. EET 1318 or EET 4318.*

EET 4320 Electricity and Electronics I (4 cl., 4 q.h.)

Introduction to circuit analysis, resistive networks, periodic excitation function, steady state a-c circuits; the physical foundations of electronics and the physical operation of electronic devices. (This course is not open to Electrical Engineering Technology majors.) *Prereq. MTH 1193 or MTH 4120 and PHY 1193 or PHY 4119.*

EET 4321 Electricity and Electronics II (4 cl., 4 q.h.)

Single-stage electronic circuits, magnetic circuits and transformers, electro-mechanical energy conversion, d-c machines, a-c machines. (This course is not open to Electrical Engineering Technology majors.) *Prereq. EET 1320 or EET 4320.*

EET 4323 Electronics Laboratory (3 lab., 2 q.h.)

Experiments dealing with laboratory equipment (meters and oscilloscopes) techniques; junction and field-effect transistor characteristics; vacuum and semiconductor diodes; power supplies, including the regulated type; silicon controlled rectifiers; resistance-coupled amplifiers using transistors, including feedback methods. *Prereq. EET 1312 or EET 4312.*

EET 4324 Circuits Laboratory I (3 lab., 2 q.h.)

Experimentation in electronic circuit theory utilizing various measurement techniques. Instrumentation verification of circuit theorems; response of circuits to steps and impulses; oscilloscope theory and applications. *Prereq. EET 1151 or EET 4151.*

EET 4325 Circuits Laboratory II (3 lab., 2 q.h.)

Further experimentation in electrical circuits and measurement techniques. Experiments include response of circuits to steps and impulses, nonlinear devices, terminal characteristics of active devices, log modulus plots, network parameters and synthesis. Fourier analysis and synthesis. *Prereq. EET 1324 or EET 4324.*

EET 4327 Advanced Electronics Laboratory I (3 lab., 2 q.h.)

Experiments dealing with the use of oscilloscopes, the examination of transistor audio amplifiers, push-pull amplifiers, drivers, pulse and video amplifiers, transients and wave-shaping circuits, audio frequency oscillators, and the study of operational amplifiers. *Prereq. EET 1323 or EET 4323.*

EET 4328 Advanced Electronics Laboratory II (3 lab., 2 q.h.)

Experiments dealing with the modulation of a class C amplifier, the diode detector, basic timing circuits, RF and crystal oscillators, astable multivibrators, logic gates, flip-flops, binary adders, registers and counters; active filters, frequency modulation detectors, and analog-to-digital and digital-to-analog conversion. *Prereq. EET 1327 or EET 4327.*

EET 4329 Advanced Electronics Laboratory III (3 lab., 2 q.h.)

Spectral studies of FM and PM waves, amplitude limiters; the balanced modulators and single sideband generators; integrated circuit timers and monolithic random access memory; monolithic phase-locked loop as well as a series of microwave experiments and a series of digital experiments. *Prereq.* EET 1328 or EET 4328.

EET 4330 Energy Conversion (4 cl., 4 q.h.)

Generalized theory of rotating energy conversion devices; steady-state operation of the multiply-excited direct-current machine; control of speed; special machines; transformers; steady-state considerations of induction and synchronous machines; generalized machine and circuit model; Laplace transform techniques applied to the analysis of dynamic operating modes of rotating machines. *Prereq.* EET 1353 or EET 4353.

EET 4337 Distributed Systems (4 cl., 4 q.h.)

Radiation, transmission, and reception of electromagnetic waves; distributed-line constants and traveling waves of transmission lines; differential equations of the uniform line. *Prereq.* MTH 1195 or MTH 4122 and PHY 1193 or PHY 4119.

EET 4180 Introduction to Telecommunications (4 cl., 4 q.h.)

Survey course covering voice, video, and data communications. Lectures will cover theory and applications of the band frequencies and descriptions of the hardware required. Course will include laboratory exercises to reinforce lecture material. *Prereq.* None.

EET 4151 Circuits Analysis I (4 cl., 4 q.h.)

Ohm's law, Kirchhoff's current and voltage laws, equivalent resistances and sources, mesh and nodal analysis, network theorems, two-port networks and power relations—all with respect to direct currents; energy storage, singularity functions, responses of R, L, and C elements to singularities. *Prereq.* MTH 1193 or MTH 4120, PHY 1193 or PHY 4119.

EET 4152 Circuits Analysis II (4 cl., 4 q.h.)

Complex algebra, phasors, frequency domain, mutual inductance, transformers, steady-state a-c theory, driving point and transfer impedances, power and energy in a-c circuits; Laplace transforms; partial fraction expansion; Laplace transform techniques applied to the solution of RLC networks. *Prereq.* EET 1151 or EET 4151.

EET 4353 Circuits Analysis III (4 cl., 4 q.h.)

Application of differential equations to the solutions of linear, time-invariant electrical networks; introduction to singularity functions, convolution, and time domain transient analysis; network topology and duality; introduction to the methods of transformation calculus and complex frequency concepts. *Prereq.* EET 1152 or EET 4152.

EET 4354 Circuits Analysis IV (4 cl., 4 q.h.)

Signal analysis in the frequency domain; Fourier series; Fourier and Laplace transform methods; a varied selection of circuit problems is solved using Laplace transforms and related theorems. *Prereq.* EET 1353 or EET 4353.

EET 4362 Basic Power Systems I (4 cl., 4 q.h.)

Consideration of power transmission lines; line constants; current voltage and power relations; introduction to electric-power distribution loads, feeders, and substations; application of matrices. *Prereq.* EET 1354 or EET 4354.

EET 4363 Basic Power Systems II (4 cl., 4 q.h.)

Consideration of symmetrical and unsymmetrical faults; protective devices—application and coordination; power flow in electric circuits; steady-state power limitations of systems; voltage regulation theory and application. *Prereq.* EET 1362 or EET 4362.

EET 4364 Basic Power Systems III (4 cl., 4 q.h.)

Computer applications to power systems with emphasis on load-flow studies; basic ideas of systems planning, short-circuit studies and system stability. *Prereq.* EET 1363 or EET 4363.

EET 4370 Digital Computers (4 cl., 4 q.h.)

Introduction to the field of digital computer design. Topics include general computer organization, number systems and number representations, design characteristics of major computer units. Boolean Algebra applications to computer design. *Prereq.* EET 1311 or EET 4311.

EET 4371 Digital Computers II (4 cl., 4 q.h.)

Examination of microprocessor architecture and organization. Study of the machine language and assembly coding of an industry-accepted microprocessor. A suitable topic selected from the current literature by the instructor will be analyzed. Assembly language coding problems will be assigned. *Prereq.* EET 1370 or EET 4370.

EET 4381 Telecommunications Systems I (4 cl., 4 q.h.)

PBX and telephone exchanges; switching and signalling systems, main frames, trunking; grounding and shielding; central office control; local area networks; transmission lines such as wire, cable, waveguide, fiber optics; integrated information systems processing and storage of signal. *Prereq.* EET 4180, EET 4152.

EET 4382 Telecommunications Systems II (4 cl., 4 q.h.)

R.F. transmission systems: wave propagation in the troposphere and ionosphere; microwave and satellite transmission and reception; mobile telephone systems; broadcast station components, control (local and remote), proof of performance, logs. *Prereq.* EET 4381.

EET 4383 Telecommunications Systems III (4 cl., 4 q.h.)

Telecommunication standards: Voice, video, and data; system installation, maintenance, and calibration; information and bandwidth; noise properties; error rates and performance factors; error detection and correction; F.C.C. requirements. *Prereq.* EET 4382.

EET 4384 Video Communications (4 cl., 4 q.h.)

The television signal, synchronization, balancing and interleaving, cameras, transmitters and receivers, video cassette recorders, video discs, and cable networks. *Prereq.* PHY 4119, EET 4180, EET 4151.

EET 4377 Control Engineering I (4 cl., 4 q.h.)

Analysis of linear servomechanisms under both transient and steady-state conditions; signal flow graphs; Laplace transforms used in the formulation of block diagrams and transfer function. *Prereq.* EET 1354 or EET 4354, MTH 1122 or MTH 4122.

EET 4378 Control Engineering II (4 cl., 4 q.h.)

System stability; root locus techniques; treatment of Nyquist criteria and Bode diagram methods for systems evaluation. *Prereq.* EET 1377 or EET 4377.

EET 4391 Basic Optics and Optical Systems Design (4 cl., 4 q.h.)

Develops the basics of optical imaging in the Gaussian approximation. Analyzes the various design considerations stemming from lens aberration, intent and forms of optical systems and flux throughput. The essentials of a wave description of light are also presented along with instrumental designs for exhibiting interference and diffraction. No previous background in optics is assumed. *Prereq.* MTH 1192 or MTH 4108, PHY 1193 or PHY 4119.

EET 4392 Optoelectronics and Fiber Optics (4 cl., 4 q.h.)

Presents an overview of the various elements and their characteristics utilized in optical communication systems. They entail those elements which generate light (lasers, diodes); modulate light (as in scanning or information encoding); transfer light (optical fibers); detect light; display and store light or its encoded information. *Prereq.* EET 4391.

Chemical Engineering Technology

CHT 1381 Nuclear Technology (4 cl., 4 q.h., Day Curriculum)

Atomic and nuclear structure; discovery and nature of radioactivity; nuclear reactions and energy; induced nuclear transformation; neutron properties; nuclear instrumentation for particle detection, monitoring, and experimentation; the fission process and its applications; nuclear reactors—their classification, design, and application; supplementary laboratory experiments. *Prereq.* MTH 1195, PHY 1193.

Industrial Engineering Technology

IIS 4360 Engineering Economy I (4 cl., 4 q.h.)

Fundamental accounting concepts and familiarization with terminology. Assets, liability, net worth. Analysis of income statement and balance sheet. Flow of funds in a firm. Sources of capital—equity, borrowed, retained earnings, depreciation and depreciation accounting, taxes. Cost of capital, time value of money, equivalence, cash flow of diagrams and tables. Development of cash flows for alternative capital expenditures, analytical methods of engineering economy, including present worth, annual cost, and rate of return. Incremental rate of return, breakeven analysis. Retirement and replacement. *Prereq.* None.

IIS 4393 Engineering Probability and Statistics (4 cl., 4 q.h.)

Algebra of events and sets. Probability measure, laws of probability. Independence, conditional probability. Random variables, discrete and continuous. Properties of random variables, including density functions, expectations, variance.

Sampling statistics. Estimation of parameters of random variables. Point and interval estimation. Hypothesis testing. Simple and composite hypothesis. One-sided and two-sided tests. Tests of measures of variances. Normal, standard deviation, F , X . *Prereq.* MTH 4123 or MTH 1196.

Computer Technology

CT 1105 Introduction to Programming (4 cl., 4 q.h., Day Curriculum)

A high-level structured language will be taught and used as a vehicle for implementing programs. Students will write and run programs using the University's computer. Topics: using the University's computer, flow charting, program construction, computations involving maxima and minima, arrays, simple recursion, subroutines. (Lab. Included) *Prereq.* None.

CT 1310 FORTRAN (4 cl., 4 q.h., Day Curriculum)

This important scientific language will be taught with engineering applications. Students will write and run FORTRAN programs using the University's computer. Topics: arithmetic replacement, input, output, control and specification statements, looping, arrays, functions and subroutines. *Prereq.* CT 1105 or CT 4105.

CT 1311 Programming With the "C" Language (4 cl., 4 q.h., Day Curriculum)

Students will write programs in "C," a general-purpose programming language useable for operating systems or numerical, text-processing, and data-base programs. A basic knowledge of programming fundamentals is assumed. Topics will cover: basic data types, operators and expressions; control-flow (if-else, while, etc.); functions and program structure; external variables; scope rules; pointers; address arithmetic; structure and union; and the C I/O Library. *Prereq.* CT 1105 or CT 4105.

CT 1320 COBOL (4 cl., 4 q.h., Day Curriculum)

This important business language will be taught with general applications. Students will write and run COBOL programs using the University's computer. Topics: divisions, names, rules, picture clauses, verbs, input/output instructions, levels, working storage, arithmetic, corresponding, accept, display, compute, copy, update logic, table logic, redefines, search, inline, and COBOL sorts. *Prereq.* CT 1105 or CT 4105.

CT 1330 Nonnumerical Algorithms (4 cl., 4 q.h., Day Curriculum)

Data: structures, storage, manipulation, and retrieval methods. Students will write and run data manipulation programs using the University's computer. Topics: stacks, queues, lists, trees, heaps, sets, graphs, hashing, searching, sorting, key processing, relational models. *Prereq.* CT 1105 or CT 4105.

CT 1335 Numerical Algorithms (4 cl., 4 q.h., Day Curriculum)

Computer methods for solving mathematical problems. Students will write and run application programs using the University's computer. Topics: deterministic vs. stochastic methods, random number generators, iterative vs. noniterative solutions, maxima and minima in 2 and 3 variables, curve fitting in 2 and 3 variables, integrals, trapezoidal and Simpsons rules, slopes, difference equations in 2 and 3 variables, vector and matrix algebra, simultaneous linear equations, nonlinear equations, permutations, and combinations. *Prereq.* CT 1310 or CT 4310.

CT 1340 Modern Programming Techniques (4 cl., 4 q.h., Day Curriculum)

Structured methods for developing complex computer software. Students will develop structured specifications, structured designs, and the computer programs for complex problems. Students will test the program on the University's computer. Topics: partitioning, hierarchical organization, data flow diagrams, data dictionaries, structured English, decision trees, decision tables, structured charts, team design, structured programs, maintainable. (Lab. Included) *Prereq.* CT 1305 or equiv.

Note: Students at suburban campuses will find it necessary periodically to come to the Boston Campus Computation Center to run their homework problems.

CT 1341 Basic Computer Organization (4 cl., 4 q.h., Day Curriculum)
Fundamental aspects of basic computer components. Topics: the functions and general operating characteristics of CPU's: primary/secondary and mass memory, controllers, printers, card readers, terminals. What an operating system does: scheduling, monitoring, spooling, paging, system programs, virtual memory, multiprogramming, multiprocessing. *Prereq.* CT 1105 or CT 4105.

CT 1342 Advanced Computer Organization (4 cl., 4 q.h., Day Curriculum)
The operating and performance characteristics of complex and special purpose components. Topics: how an operating system works, memory hierarchies, fiber optics, bubble memory, mass storage, computer networks, distributed processing, data flow, cache memory, associative memory, special purpose/parallel processor, system performance measure. *Prereq.* CT 1375 or CT 4375.

CT 1345 Assembly Language (4 cl., 4 q.h., Day Curriculum)
A typical microprocessor assembly language will be taught. Students will write and run homework problems using a microprocessor simulator package implemented on the University's computer. Topics: binary arithmetic, instruction sets, addressing modes, code conversion, subroutines, macros, I/O, *Prereq.* CT 1105 or CT 4105.

CT 1355 Microperipheral Hardware (4 cl., 4 q.h., Day Curriculum)
The elements of microprocessor peripheral hardware and its interfacing. Students will configure microprocessor systems, using block diagrams showing relevant handshaking signals. Topics: serial and parallel I/O devices, DMA and interrupt control devices, bus arbitration, memory management units, counter timers as extensions of basic CPU functions. *Prereq.* CT 1375 or CT 4375.

CT 1356 Complex Peripheral Hardware (4 cl., 4 q.h., Day Curriculum)
The interfacing and implementation of special purpose hardware. Students will configure systems, using block diagrams showing relevant handshaking signals. Topics: virtual memory, rotating media, printers, terminals, bus extension concepts, coprocessors. *Prereq.* CT 1355 or CT 4355.

CT 1360 Industry Software (4 cl., 4 q.h., Day Curriculum)
A survey of current commercial software packages and methods. Students will exercise commercial packages on the University's computer where applicable. Topics: specific packages and methods which vary from year to year to maintain currency. They will be drawn from the following general categories: data base management, scientific and statistical analysis, security and privacy, software assurance, and documentation. *Prereq.* CT 1341 or CT 4351 and CT 4310.

CT 1365 Industry Hardware (4 cl., 4 q.h., Day Curriculum)
A survey of the latest industrial developments and trends in computer hardware. Conducted as a seminar. *Prereq.* CT 1356 or CT 4356.

CT 1368 Semiconductor Logic (4 cl., 4 q.h., Day Curriculum)
A detailed analysis of the bipolar and MOS transistors in saturated and cutoff conditions. Implementation of these concepts to form basic logic and decision-making circuits. Students will convert logical expressions into hardware configuration representations. Topics: Ebers-Moll modeling, PMOS, NMOS, CMOS construction, logic families. *Prereq.* EET 1311 or EET 4311.

CT 1369 Computer Logic (4 cl., 4 q.h., Day Curriculum)
An introduction to the hardware building blocks of general computers. Students will specify configurations of lower level components to achieve composite logical functions, e.g., construct a register from NAND gates. Topics: gates, flip-flops, registers, decoders, ALU's memory arrays. (Lab. Included) *Prereq.* CT 1368 or CT 4368.

CT 1374 Introduction to CPU Hardware (4 cl., 4 q.h., Day Curriculum)

The internal operation of a microprocessor CPU. A black box approach is used to consider interfacing with peripheral equipment. Design problems and situations that arise in using microprocessors in industrial applications will be considered. Topics: registers and timing control, programmable gate arrays, array processors as CPU models. (Lab. Included) *Prereq.* CT 1345 or CT 4345.

CT 1375 CPU Hardware Architecture (4 cl., 4 q.h., Day Curriculum)

The performance characteristics of commercially available CPU's. Students will write code for 4-bit through 32-bit processors. Topics: the characteristics of 4004, 4008, 8080, Z80, Z8000, 8086, 1802, F3, and 6800 processors, and how to use one processor in place of another. Note: the list of processors examined may vary from year to year to maintain currency. *Prereq.* CT 1374 or CT 4374.

CT 1380 Data Communication Methods (4 cl., 4 q.h., Day Curriculum)

Functional and operational aspects of data communication devices and software. A black box approach will be used. Topics: modems, control units, multiplexers, concentrators, front end processors, synchronous/asynchronous/half duplex/full duplex codes and procedures, Bisynch/SDLE/HDLC, BYTE and BIT protocols, error checking, point to point/multidrop/STAR/MESH/CLUSTER networks. *Prereq.* CT 1310 or CT 4310.

CT 1381 Operating Systems (4 cl., 4 q.h., Day Curriculum)

The basic principles of operating system implementation. Students write and run programs to exercise elements of the University's operating system when applicable. Topics: resource, memory, processor and device management commands and strategies, I/O programming, swapping, overlays, jobs and process scheduling, and other operating systems. *Prereq.* CT 1342 or CT 4351.

CT 1382 Computer Graphics Programming (4 cl., 4 q.h., Day Curriculum)

Students are introduced to generalized techniques for the computer plotting of 2- and 3-dimensional shapes. Students write and run programs using the University's computer and digital plotter. Topics: 2D transforms, 3D to 2D transforms, 3D transforms, surface representation, shading, characters, curve fitting, graphic data structures. *Prereq.* CT 1310 or CT 4310.

CT 1383 Data Bases (4 cl., 4 q.h., Day Curriculum)

An introduction to data base organization structure and management. Students write and run programs exemplifying techniques developed in class on the University's computer. Topics: access methods, attributes, indices, keys, querying, searching and matching, file sets, inverted file sets, normal forms, random access. *Prereq.* CT 1330 or CT 4330.

CT 1384 Large System Assembly Languages (4 cl., 4 q.h., Day Curriculum)

Typical large computer system assembly languages. Students will write and run illustrative programs on the University's computer. Topics: edit and translate instructions, macro writing, program sectioning, linking, data representation, addressing, instruction formats in BAL and VAX-11 assembler languages. *Prereq.* CT 1345 or CT 4345.

CT 1385 Introduction to Simulation Programming (4 cl., 4 q.h., Day Curriculum)

Computer methods for solving simulated phenomena. Students will write and run programs implementing simulations specified by instructors. Students will not be responsible for the validity or evaluation of models except in simple cases. Topics: simple queues; multiserver queues; priorities, including first in first out, last in last out, and time aging of data; simple frequency distributions; use of SIMULA, GPSS, and Standard Subroutine Library Routines. *Prereq.* GCT 1335 or GCT 4335.

CT 1386 Development System Hardware (4 cl., 4 q.h., Day Curriculum)

A study of the principal hardware capabilities and current trends in micro computer level systems. Included are both single users and network-oriented systems. *Prereq.* CT 1375 or CT 4375.

CT 1387 Bit Slice Micro Computers (4 cl., 4 q.h., Day Curriculum)

The epitome of hardware flexibility is represented by the bit slice CPU. Demonstrates the basic design ground rules common to this style of hardware design. *Prereq.* CT 1355 or CT 4355.

CT 1388 Micro Controllers (4 cl., 4 q.h., Day Curriculum)

The commercial segment of micro computers has been satisfied by a variety of single chip 4-bit micro controllers. A detailed contrast/comparison will be done on several of these devices, including the IMS-1000, S2000, COPS, and PPS-4. *Prereq.* CT 1374 or CT 4374.

CT 1389 Single Chip Microprocessors (4 cl., 4 q.h., Day Curriculum)

When small 8-bit intelligent devices are rewired in high volume, the single chip microprocessor in the form of the 3870, 8048, Z8 and others come into play. An understanding of the hardware limitations of a single chip system presents the basis for this subject material. *Prereq.* CT 1374 or CT 4374.

CT 1390 Special Problems in Computer Technology (4 cl., 4 q.h., Day Curriculum)

Theoretical or experimental work under individual faculty supervision. *Prereq.* Consent of department chairperson.

CT 4105 Introduction to Programming (4 cl., 4 q.h.)

A high-level structured language will be taught and used as a vehicle for implementing programs. Students will write and run programs using the University's computer. Topics: using the University's computer, flow charting, program construction, computations involving maxima and minima, arrays, simple recursion, subroutines. (Lab. Included) *Prereq.* None.

CT 4310 FORTRAN (4 cl., 4 q.h.)

This important scientific language will be taught with engineering applications. Students will write and run FORTRAN programs using N.U.'s computer. Topics: arithmetic replacement, input, output, control and specification statements, looping, arrays, functions and subroutines. *Prereq.* CT 4105 or equiv.

CT 4311 Programming with the "C" Language (4 cl., 4 q.h.)

Students will write programs in "C," a general-purpose programming language useable for operating systems or numerical, text-processing, and data-base programs. A basic knowledge of programming fundamentals is assumed. Topics will cover: basic data types, operators and expressions, control-flow (if-else, while, etc.), functions and program structure, external variables, scope rules, pointers, address arithmetic, structure and union, and the C I/O Library. *Prereq.* GCT 4105 or GCT 1105.

CT 4320 COBOL (4 cl., 4 q.h.)

This important business language will be taught with general applications. Students will write and run COBOL programs using N.U.'s computer. Topics: divisions, names, rules, picture clauses, verbs, input/output instructions, levels, working storage, arithmetic, corresponding, accept, display, compute, copy, update logic, table logic, redefines, search, inline, and COBOL sorts. *Prereq.* CT 4105 or CT 1105 or equiv.

CT 4330 Nonnumerical Algorithms (4 cl., 4 q.h.)

Data: structures, storage, manipulation, and retrieval methods. Students will write and run data manipulation programs using N.U.'s computer. Topics: stacks, queues, lists, trees, heaps, sets, graphs, hashing, searching, sorting, key processing, relational models. *Prereq.* CT 4105.

CT 4335 Numerical Algorithms (4 cl., 4 q.h.)

Computer methods for solving mathematical problems. Students will write and run application programs using N.U.'s computer. Topics: deterministic vs. stochastic methods, random number generators, iterative vs. noniterative solutions, maxima and minima in 2 and 3 variables, curve fitting in 2 and 3 variables, integrals, trapezoidal and Simpsons rules, slopes, difference equations in 2 and 3 variables, vector and matrix algebra, simultaneous linear equations, nonlinear equations, permutations, and combinations. *Prereq.* CT 4310 or equiv.

CT 4340 Modern Programming Techniques (4 cl., 4 q.h.)

Structured methods for developing complex computer software. Students will develop structured specifications, structured designs, and the computer programs for complex problems. Students will test the programs on the University's computer. Topics: partitioning, hierarchical organization, data flow diagrams, data dictionaries, structured English, decision trees, decision tables, structured charts, team design, structured programs, maintainability. (Lab. Included) *Prereq.* CT 4105 or equiv.

CT 4345 Assembly Language (4 cl., 4 q.h.)

A typical microprocessor assembly language will be taught. Students will write and run homework problems using a microprocessor simulator package implemented on N.U.'s computer. Topics: binary arithmetic, instruction sets, addressing modes, code conversion, subroutines, macros, I/O. *Prereq.* CT 4105.

CT 4350 Basic Computer Organization (4 cl., 4 q.h.)

Fundamental aspects of basic computer components. Topics: the functions and general operating characteristics of CPU's: primary/secondary and mass memory, controllers, printers, card readers, terminals. What an operating system does: scheduling, monitoring, spooling, paging, system programs, virtual memory, multiprogramming, multiprocessing. *Prereq.* CT 4105 or equiv.

CT 4351 Advanced Computer Organization (4 cl., 4 q.h.)

The operating and performance characteristics of complex and special purpose components. Topics: how an operating system works, memory hierarchies, fiber optics, bubble memory, mass storage, computer networks, distributed processing, data flow, cache memory, associative memory, special purpose/parallel processors, system performance measures. *Prereq.* CT 4105 or equiv.

CT 4355 Micro Peripheral Hardware (4 cl., 4 q.h.)

The elements of microprocessor peripheral hardware and its interfacing. Students will configure microprocessor systems, using block diagrams showing relevant handshaking signals. Topics: serial and parallel I/O devices, DMA and interrupt control devices, bus arbitration, memory management units, counter timers as extensions of basic CPU functions. *Prereq.* CT 4375 or equiv.

CT 4356 Complex Peripheral Hardware (4 cl., 4 q.h.)

The interfacing and implementation of special purpose hardware. Students will configure systems, using block diagrams showing relevant handshaking signals. Topics: virtual memory, rotating media, printers, terminals, bus extension concepts, co-processors. *Prereq.* CT 4355 or equiv.

CT 4360 Industry Software (4 cl., 4 q.h.)

A survey of current commercial software packages and methods. Students will exercise commercial packages implemented on N.U.'s computer where applicable. Topics: specific packages and methods which vary from year to year to maintain currency. They will be drawn from the following general categories: data base management, scientific and statistical analysis, security and privacy, software assurance, and documentation. *Prereq.* CT 4310, CT 4351 or *equiv.*

CT 4365 Industry Hardware (4 cl., 4 q.h.)

A survey of the latest industrial developments and trends in computer hardware. Conducted as a seminar. *Prereq.* CT 4356 or *equiv.*

CT 4368 Semiconductor Logic (4 cl., 4 q.h.)

A detailed analysis of the bipolar and MOS transistors in saturated and cutoff conditions. Implementation of these concepts to form basic logic and decision-making circuits. Students will convert logical expressions into hardware configuration representations. Topics: Ebers-Moll modeling, PMOS, NMOS, CMOS construction, logic families. *Prereq.* EET 4311 or *equiv.*

CT 4369 Computer Logic (4 cl., 4 q.h.)

An introduction to the hardware building blocks of general computers. Students will specify configurations of lower level components to achieve composite logical functions, e.g., construct a register from NAND gates. Topics: gates, flip-flops, registers, decoders, ALU's, memory arrays. (Lab. Included) *Prereq.* CT 4368 or *equiv.*

CT 4374 Introduction to CPU Hardware (4 cl., 4 q.h.)

The internal operation of a microprocessor CPU. A black box approach is used to consider interfacing with peripheral equipment. Design problems and situations that arise in using microprocessors in industrial applications will be considered. Topics: registers and timing control, programmable gate arrays, array processors as CPU models. (Lab. Included) *Prereq.* CT 4345 or *equiv.*

CT 4375 CPU Hardware Architecture (4 cl., 4 q.h.)

The performance characteristics of commercially available CPU's. Students will write code for 4 bit through 32 bit processors. Topics: the characteristics of 4004, 4008, 8080, Z80, Z8000, 8086, 1802, F8, and 6800 processors, and how to use one processor in place of another. Note: the list of processors examined may vary from year to year to maintain currency. *Prereq.* CT 4374 or *equiv.*

CT 4380 Data Communication Methods (4 cl., 4 q.h.)

Functional and operational aspects of data communication devices and software. A black box approach will be used. Topics: modems, control units, multiplexers, concentrators, front end processors, synchronous/asynchronous/half duplex/full duplex codes and procedures, Bisynch/SDLE/HDLC, BYTE and BIT protocols, error checking, point to point/multidrop/STAR/MESH/CLUSTER networks. *Prereq.* CT 4310 or *equiv.*

CT 4381 Operating Systems (4 cl., 4 q.h.)

The basic principles of operating system implementation. Students write and run programs to exercise elements of the University's operating system when applicable. Topics: resource, memory, processor and device management commands and strategies, I/O programming, swapping, overlays, jobs and process scheduling, and other operating systems. *Prereq.* CT 4351 or *equiv.*

CT 4382 Computer Graphics Programming (4 cl., 4 q.h.)

Students are introduced to generalized techniques for the computer plotting of 2 and 3 dimensional shapes. Students write and run programs using the University's computer and digital plotter. Topics: 2D transforms, 3D to 2D transforms, 3D transforms, surface representation, shading, characters, curve fitting, graphic data structures. *Prereq. CT 4310 or equiv.*

CT 4383 Data Bases (4 cl., 4 q.h.)

An introduction to data base organization structure and management. Students write and run programs exemplifying techniques developed in class on the University's computer. Topics: access methods, attributes, indices, keys, querying, searching and matching, file sets, inverted file sets, normal forms, random access. *Prereq. CT 4330 or equiv.*

CT 4384 Large System Assembly Languages (4 cl., 4 q.h.)

Typical large computer system assembly languages. Students will write and run illustrative programs on the University's computer. Topics: edit and translate instructions, macro writing, program sectioning, linking, data representation, addressing, instruction formats in BAL and VAX-11 assembler languages. *Prereq. CT 4345 or equiv.*

CT 4385 Introduction to Simulation Programming (4 cl., 4 q.h.)

Computer methods for solving simulated phenomena. Students will write and run programs implementing simulations specified by instructor. Students will not be responsible for the validity or evaluation of models except in simple cases. Topics: simple queues, multiserver queues, priorities including first in first out, last in last out, and time aging of data, simple frequency distributions, use of SIMULA, GPSS, and Standard Subroutine Library Routines. *Prereq. CT 4335 or equiv.*

CT 4386 Development System Hardware (4 cl., 4 q.h.)

A study of the principal hardware capabilities and current trends in micro computer level systems. Included are both single users and network-oriented systems. *Prereq. CT 4375 or equiv.*

CT 4387 Bit Slice Microcomputers (4 cl., 4 q.h.)

The epitome of hardware flexibility is represented by the bit slice CPU. Demonstrates the basic design ground rules common to this style of hardware design. *Prereq. CT 4355 or equiv.*

CT 4388 Microcontrollers (4 cl., 4 q.h.)

The commercial segment of micro computers has been satisfied by a variety of single chip 4 bit micros controllers. A detailed contrast/comparison will be done on several of these devices, including the IMS-1000, S2000, COPS, and PPS-4. *Prereq. CT 4374 or equiv.*

CT 4389 Single Chip Microprocessors (4 cl., 4 q.h.)

When small 8 bit intelligent devices are rewired in high volume, the single chip microprocessor in the form of the 3870, 8048, Z8, and others comes into play. An understanding of the hardware limitations of a single chip system presents the basis for this subject material. *Prereq. CT 4374 or equiv.*

CT 4390 Special Problems in Computer Technology (4 cl., 4 q.h.)

Theoretical or experimental work under individual faculty supervision. *Prereq. Consent of department chairperson.*

General Engineering Technology

GET 1100 Computer Programming for Engineering Technology (4 cl., 4 q.h., Day Curriculum)

Introduction to the use of computers in the solution of problems using FORTRAN on interactive terminals. Students write and run programs to compute sequences, averages, etc. Other capabilities of the FORTRAN language, including DO loops, subscripted variables, and alphanumeric manipulation, matrix algebra, and numerical methods. *Prereq.* MTH 1108 or MTH 4108 or concurrently.

GET 1301 FORTRAN for Engineering Computation (4 cl., 4 q.h., Day Curriculum)

Professional methods for solving engineering problems with FORTRAN. Students will write and run programs using the University's computer. Topics include: subprograms, scientific software packages, solution of equations, data storage, reduction and display. *Prereq.* GET 1100 or GET 4100.

GET 1315 Pascal (A Second Language) (4 cl., 4 q.h., Day Curriculum)

An introductory course in programming computers using the Pascal language. Students will write and run programs using the University's computer facilities. This course may not be used as a technical elective in the Computer Technology Program. *Prereq.* CT 1100 or CT 4100.

GET 1364 Kinematics (4 cl., 4 q.h., Day Curriculum)

Study of four-bar linkages, sliders, etc., using orthogonal components of vectors, instantaneous centers, equivalent linkages, effective cranks, etc., emphasizing graphical solutions, including an introduction to the computer to enhance these concepts. Reverted and epicyclic gear trains are analyzed, as are cam displacement, velocity, and acceleration diagrams. *Prereq.* GET 1171, GET 1100, PHY 1191.

GET 1170 Engineering Graphics I (4 cl., 4 q.h., Day Curriculum)

The study of concepts and the development of skills to present and to analyze objects and systems used in design through the principles of graphical geometric constructions, orthographic projections (multi-view, two-dimensional drawings), and the design process. Assignments will include the layout of drawings on the paper, solutions to graphical problems concerning objects and systems, and complete solutions to short problems using the design process. *Prereq.* None.

GET 1171 Engineering Graphics II (4 cl., 4 q.h., Day Curriculum)

Continuation of the study of concepts and the development of skills to present and to analyze objects and systems used in design, including dimensioning, sectioning, threads, fasteners, assembly and detail drawings, as well as the design process. Assignments will require solutions to graphical problems that will require the studied graphical material and a progress report leading to the solution of a design problem. *Prereq.* GET 1170 or equiv.

GET 1172 Electrical Engineering Graphics (4 cl., 4 q.h., Day Curriculum)

Introduction to electronic graphics, including symbols, schematics, block and logic diagrams, production and cable drawings, military standards. A study of single- and double-sided printed circuit layout, integrated circuits, electro-mechanical designs, wiring, and interconnection diagrams; graphical data presentation. *Prereq.* GET 1170 or equiv.

GET 4100 Computer Programming for Engineering Technology (4 cl., 4 q.h.)
Introduction to the use of computers in the solution of problems using FORTRAN on interactive terminals. Students write and run programs to compute sequences, averages, etc. Other capabilities of the FORTRAN language, including DO loops, subscripted variables, and alphanumeric manipulation, matrix algebra, and numerical methods. *Prereq.* MTH 4108 or MTH 1108 or concurrently.

GET 4301 FORTRAN Engineering Computation (4 cl., 4 q.h.)
Professional methods for solving engineering problems with FORTRAN. Students will write and run programs using the University's computer. Topics include: subprograms, scientific software packages, solution of equations, data storage, reduction and display. *Prereq.* GCT 4100 or GCT 1100.

GET 4138 Computer Programming for Telecommunications (4 cl., 4 q.h.)
An introduction to computers and their programming. The student will be introduced to the major components of the computer and how they function together. Programming topics will include algorithms, programming philosophy, and flow charts. A high-level language will be taught to enable students to write programs and run them on Northeastern University's computer. *Prereq.* None.

GET 4306 Technical Communications I (3 q.h.)
Experiments with inexpensive and practical techniques to create competitive written and spoken presentations of a professional calibre. Topics include written and spoken presentations and audio-visual aids and presentations. *Prereq.* ENG 4111 and GET 4170.

GET 4307 Technical Communications II (3 q.h.)
Experiments in the organizing, researching, and writing techniques essential to engineering management. The course leads students through an intensive examination and utilization of professional technical writing techniques. *Prereq.* GET 4306.

GET 4315 Pascal (A Second Language) (4 cl., 4 q.h.)
An introductory course in programming computers using the Pascal language. Students will write and run programs using the University's computer facilities. This course may not be used as a technical elective in the Computer Technology Program. *Prereq.* GET 4100 or equivalent.

GET 4364 Kinematics (4 cl., 4 q.h.)
Study of four-bar linkages, sliders, etc., using orthogonal components of vectors, instantaneous centers, equivalent linkages, effective cranks, etc., emphasizing graphical solutions, including an introduction to the computer to enhance these concepts. Reverted and epicyclic gear trains are analyzed, as are cam displacement, velocity, and acceleration diagrams. *Prereq.* GET 4171, GET 4100, PHY 4117.

GET 4170 Engineering Graphics I (4 cl., 4 q.h.)
Introduction to engineering drawing by geometric constructions, charting, and graphs. Orthographic projection, including reading, sketching, and auxiliary views. Axonometric drawing and elements of descriptive geometry. Section and conventions. *Prereq.* None.

GET 4171 Engineering Graphics II (4 cl., 4 q.h.)
Determination of design project. Intersections and development. Manufacturing processes and dimensioning, including true position tolerancing. Threads and fasteners. Making and reading assembly drawing. Topographical and earth work drawings as applicable to civil engineers. Case studies of engineering problems and introduction of computer-aided design. Presentation of design project. *Prereq.* GET 4170 or equiv.

GET 4172 Electrical Engineering Graphics (4 cl., 4 q.h.)

Introduction to electronic graphics, including symbols, schematics, block and logic diagrams, production and cable drawings, military standards. A study of single- and double-sided printed circuit layout, integrated circuits, electro-mechanical designs, wiring, and interconnection diagrams; graphical data presentation. *Prereq.* GET 4170 or equiv.

Mathematics

MTH 4116 Probability and Statistics I (2 cl., 2 q.h.)

(Appropriate for both engineering and non-engineering students)
Basic tools, e.g., sets, permutations and combinations; probability and its applications; discrete and continuous random variables. *Prereq.* MTH 4108 or equiv.

MTH 4117 Probability and Statistics II (2 cl., 2 q.h.)

Frequency distributions and probability density functions; binomial, normal, and other distributions; central limit theorem; hypothesis testing; analysis of variance; correlation; statistical inference and estimation. Examples taken from many different fields. *Prereq.* MTH 4116 or equiv.

MTH 4118 Probability and Statistics III (2 cl., 2 q.h.)

Contingency tables; simple linear regression; multiple regression; model building. *Prereq.* MTH 4117 or equiv.

MTH 4104 Pre-Calculus Mathematics (4 cl., 4 q.h., Summer Quarter only)

Treats those topics in algebra, trigonometry, and analytical geometry which will be of greatest value to the beginning calculus student. *Prereq.*

MTH 1191 College Algebra and Trigonometry I (4 cl., 4 q.h., Day Curriculum)

Fundamental algebraic operations; complex numbers; radicals and exponents; functions; linear and quadratic equations; irrational equations; inequalities; variation; roots of polynomial equations. *Prereq.* Mathematics placement test or MTH 4082.

MTH 1192 College Algebra and Trigonometry II (4 cl., 4 q.h., Day Curriculum)

Logarithms; trigonometric functions of angles in degrees and radians; trigonometric identities and equations; right triangles; oblique triangles; complex numbers in trigonometric form; systems of equations; determinants. *Prereq.* MTH 1191 or MTH 4107.

MTH 1193 Calculus I (4 cl., 4 q.h., Day Curriculum)

Plane analytic geometry; differentiation of algebraic functions; rate, motion, maximum and minimum problems; derivations of higher order; curve sketching; basics in functions, limits, and continuity. *Prereq.* MTH 1192 or MTH 4108.

MTH 1194 Calculus—A (4 cl., 4 q.h., Day Curriculum)

Applications of derivatives to curvesketching; antidifferentiation; the definite integral, with applications; calculus of nonalgebraic functions—logarithmic, exponential, and trigonometric; calculus of inverse trigonometric functions; techniques of integration; indeterminate forms; L'Hospital's rule. *Prereq.* MTH 1193 or MTH 4120, either CT 1105 or CT 4105 or GET 1100 or GET 4100.

MTH 1195 Calculus—B (4 cl., 4 q.h., Day Curriculum)

Calculus of functions of several variables; partial differentiation; multiple integrals; infinite series; vector analysis; polar coordinates; vectors in a plane. *Prereq.* MTH 1194 or MTH 4121.

MTH 1196 Differential Equations (4 cl., 4 q.h., Day Curriculum)

Ordinary differential equations—standard types of the first order; linear differential equations, especially with constant coefficients; Laplace transforms; series solutions of differential equations; Fourier series; and orthogonal functions. *Prereq.* MTH 1195 or MTH 4122.

MTH 4107 College Algebra I (4 cl., 4 q.h.)

Fundamental algebraic operations; complex numbers; radicals and exponents; functions; linear and quadratic equations; irrational equations; inequalities; variation; roots of polynomial equations. *Prereq.* *Mathematics placement test* or MTH 4082.

MTH 4108 Introduction to Calculus (4 cl., 4 q.h.)

Logarithms; trigonometric functions of angles in degrees and radians; trigonometric identities and equations; right triangles; oblique triangles; complex numbers in trigonometric form; systems of equations; determinants. *Prereq.* MTH 4107 or MTH 1107.

MTH 4120 Calculus I (4 cl., 4 q.h.)

Plane analytic geometry; differentiation of algebraic functions; rate, motion, maximum and minimum problems; deviations of higher order; curve sketching; basics in functions, limits, and continuity. *Prereq.* MTH 4108 or MTH 1108.

MTH 4121 Calculus—A (4 cl., 4 q.h.)

Applications of derivatives to curvesketching; antidifferentiation; the definite integral, with applications; calculus of nonalgebraic functions—logarithmic, exponential, and trigonometric; calculus of inverse trigonometric functions; techniques of integration; indeterminate forms; L'Hospital's rule. *Prereq.* MTH 4120 or MTH 1120.

MTH 4122 Calculus—B (4 cl., 4 q.h.)

Calculus of functions of several variables; partial differentiation; multiple integrals; infinite series; vector analysis; ordinary differential equations—standard types of the first order; some applications; special differential equations of the second order. *Prereq.* MTH 4121 or MTH 1121.

MTH 4123 Calculus—C (4 cl., 4 q.h.)

Linear differential equations with constant coefficients, homogeneous and nonhomogeneous; variation of parameters, simultaneous differential equations; Laplace transform; series and solution of differential equations by series; Fourier series; orthogonal functions. *Prereq.* MTH 4122 or MTH 1122.

MTH 4081 Introduction to Mathematics I (4 cl., 4 q.h.)

This credit cannot be used in the Associate in Engineering, Associate in Science, or the Bachelor of Engineering Technology degree programs. A comprehensive review of high school algebra, including first-degree equations, factoring, fractions, fractional equations, ratio and proportion, word problems, and concepts of plane geometry. *Prereq.* *None.*

MTH 4082 Introduction to Mathematics II (4 cl., 4 q.h.)

This credit cannot be used in the Associate in Engineering, Associate in Science, or the Bachelor of Engineering Technology degree programs. Algebraic operations with complex fractions, mixed expressions, square roots, radicals, quadratic equations; simultaneous equations, graphs and fractional zero and negative exponents; the geometry of the right triangle, areas of polygons, circles, and loci problems. *Prereq.* MTH 4081.

MTH 4083 Applied Mathematics & Statistics (3 q.h.)

The use of mathematics as a guide to concise thinking; the application of mathematical methods to highlight significant data. The use of elementary analytical models to test and evaluate hypotheses. An examination of the role of chance in physical phenomena. The importance of the use of a relevant statistical model. Methods for the selection of a data base. *Prereq.* MTH 4082 or equiv.

Physics

*Courses marked * not available in every curriculum. See curricula and Academic Programs of Instruction section for applicable sequence, pp. 53–85.*

PHY 1191 Physics I (Mechanics) (4 cl., 4 q.h., Day Curriculum)

Kinematics and dynamics of particle motion; Newton's laws; projectile and circular motion; conservation laws for momentum and energy; rational motion; simple harmonic motion. *Prereq.* MTH 1191 or concurrently.

PHY 1192 Physics II (Properties of Matter, Heat, Wave Motion, Sound, Light) (4 cl., 4 q.h.)

Elasticity; density and pressure; temperature; expansion; heat; change of state; heat transfer; vibrating systems; wave motion; properties of sound; properties of light. *Prereq.* PHY 1191.

PHY 1193 Physics III (Electricity, Magnetism) (4 cl., 4 q.h., Day Curriculum)

Electrostatics; circuit elements; direct current circuits; magnetism; electromechanical devices; alternating current circuits; electronics; electromagnetic waves. *Prereq.* PHY 1192.

PHY 1194 Physics Laboratory I (2½ lab., 2 q.h., Day Curriculum)

First quarter of a two-quarter physics laboratory. Experiments in mechanics, fluid dynamics, and gas laws. *Prereq.* PHY 1192.

PHY 1195 Physics Laboratory II (2½ lab., 2 q.h., Day Curriculum)

A continuation of PHY 1194. Experiments in wave motion, optics, and electrical circuits. *Prereq.* PHY 1194.

***PHY 4104 General Physics I (2 cl., 2 q.h.)**

Survey of Newtonian mechanics; kinematics, and dynamics of particle motion; projectile and circular motion; conservation laws of energy and momentum. *Prereq.* MTH 4110 or concurrently.

***PHY4105 General Physics II (2 cl., 2 q.h.)**

Temperature; heat energy; mechanical equivalent of heat; wave motion; sound; Doppler's effect; elasticity and simple harmonic motion; rotational motion; fluids at rest in motion. *Prereq.* PHY 4104.

***PHY 4106 General Physics III (2 cl., 2 q.h.)**

Fundamentals of electricity and magnetism; fields; potential; electric current; inductance; capacitance; electromagnetism; a-c and d-c series circuits; properties of light, simple optical systems. *Prereq.* PHY 4105.

PHY 4107 Physics I (Mechanics) (4 cl., 4 q.h.)

Vectors and balanced forces; accelerated motion; Newton's laws; projectile motion; work and energy; momentum; angular motion; centripetal force; rotation of rigid bodies; moment of inertia. *Prereq.* MTH 4107 or MTH 1191 or concurrently.

PHY 4118 Physics II (Properties of Matter, Heat, Wave Motion, Sound, Light) (4 cl., 4 q.h.)

Elasticity; density and pressure; temperature; the gas laws; heat transfer; thermodynamics; vibratory motion; wave motion; properties of sound; properties of light. *Prereq.* PHY 4117 or PHY 1191.

PHY 4119 Physics (Electricity, Magnetism) (4 cl., 4 q.h.)

Electrostatics; circuit elements; direct current circuits magnetism; electromechanical devices; alternating current circuits; electronics; electromagnetic waves. *Prereq.* PHY 4118 or PHY 1192.

PHY 4124 Introductory Survey of Lasers (2 cl., 2 q.h.)

Physical principles and technology will be emphasized. Includes a review of the fundamental concepts of light and spectroscopy, the basic theory of lasers, studies of solid state; atomic, ionic, and molecular gas; organic dye; and semiconductor lasers. Related optics and detection will be discussed. *Prereq.* PHY 4119.

PHY 4173 Physics Laboratory I (2½ cl., 2 q.h.)

First quarter of a two-quarter physics laboratory. Experiments in mechanics, fluid dynamics, and gas laws. *Prereq.* PHY 4105 or PHY 4118 or concurrently.

PHY 4174 Physics Laboratory II (2½ cl., 2 q.h.)

A continuation of PHY 4173. Experiments in wave motion, optics, and electrical circuits. *Prereq.* PHY 4173.

PHY 4081 Introductory Physics I (4 cl., 4 q.h.)

This credit cannot be used in the Associate in Engineering, Associate in Science, or the Bachelor of Engineering Technology degree programs. An introduction to mechanics: units of measurement, vectors, accelerated motion, and Newton's laws of motion. *Prereq.* None.

PHY 4082 Introductory Physics II (4 cl., 4 q.h.)

This credit cannot be used in the Associate in Engineering, Associate in Science, or the Bachelor of Engineering Technology degree programs. Continuation of mechanics: conservation of energy and momentum. Introduction to elements of heat, thermodynamics, light, and electromagnetism. *Prereq.* PHY 4081.

Technical Communications Technology

TCC 1301 Technical Communications (4 cl., 4 q.h., Day Curriculum)

Thought organization and effective sentences; written reports and instruction manuals; specifications and proposals; graphic aids and reproduction processes. *Prereq.* ENG 4111.

TCC 4350 Concepts of Modern Technology I (3 q.h.)

A survey of the applications of physical science to mechanical devices. An introduction to the laws of thermodynamics. The influence of material properties on design and manufacturing techniques. *Prereq.* MTH 4082 or equiv.

TCC 4351 Concepts of Modern Technology II (3 q.h.)

A survey of the applications of physical science to electrical and electronic devices. An introduction to electronic circuit design. A comparison of various devices used for amplification and control. A study of the development of the electronic digital computer and the components involved in the manufacture of computers. *Prereq.* TCC 4350.

TCC 4352 Measurement and Analysis (3 q.h.)

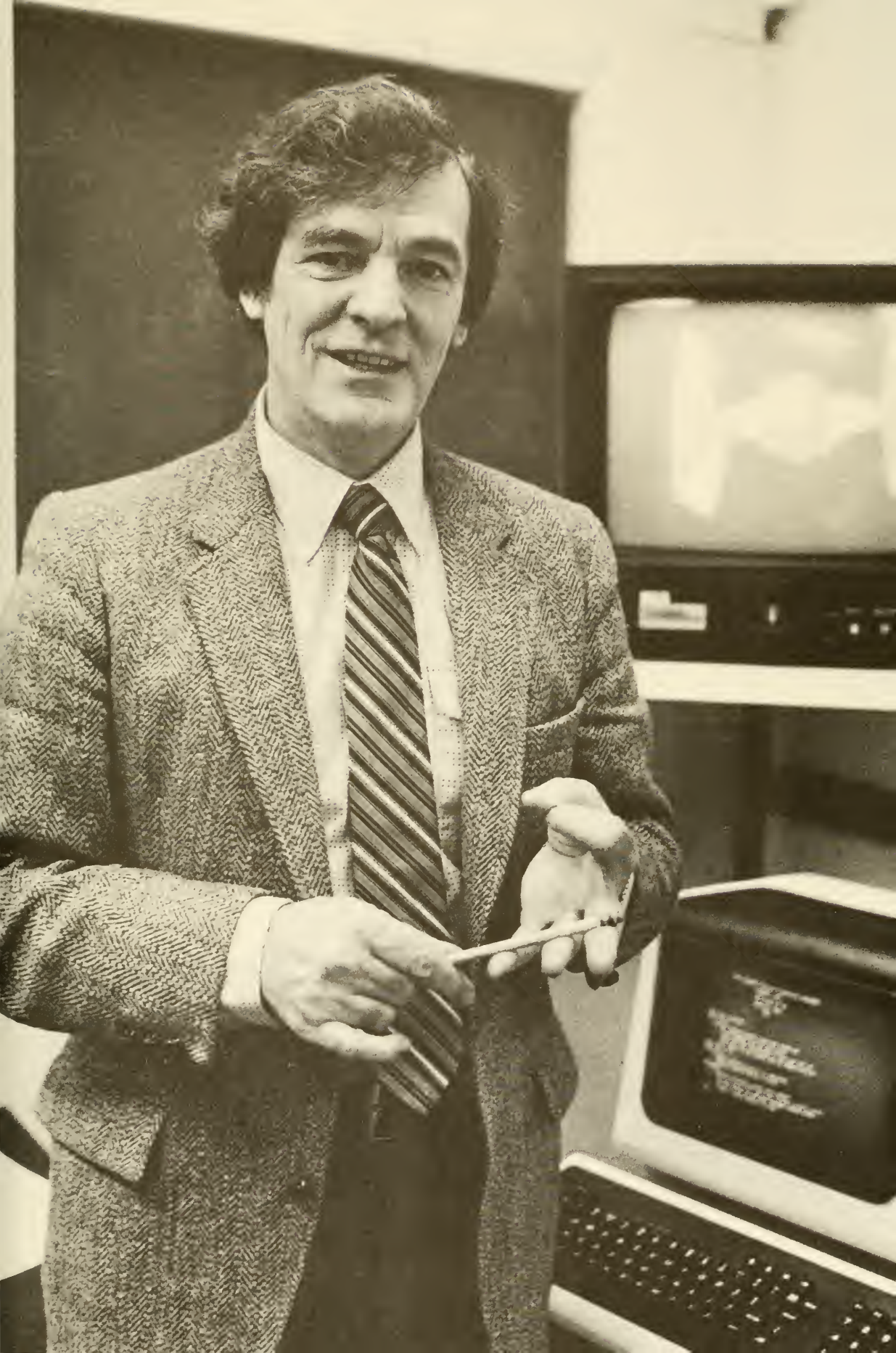
A survey of instruments and techniques used to assure performance of electrical and mechanical components. An introduction to trouble-shooting and automated testing. A study of destructive and nondestructive tests and their relationship to each other. *Prereq.* TCC 4350 and TCC 4351.

TCC 4353 Modern Electronics (3 q.h.)

A survey of components available to the designer of electronic devices, including linear integrated circuits and digital building blocks. Topics discussed will include: operational amplifier characteristics; truth tables and the synthesis of digital logic; logic families and specifications; counters, registers and decoding; digital instruments, digital to analog conversion. *Prereq.* TCC 4351.

TCC 4354 Theory and Operation of Computers (3 q.h.)

An introduction to digital computer design and operation. Design topics include Boolean Algebra, synthesis of switching networks, and an introduction to general computer architecture and organization. Operational topics include input and output devices, systems development, programming tools, data communication, time sharing, data-base principle. *Prereq.* MTH 4082 or equiv.



Lincoln College Faculty

The strength of an educational institution lies in the quality of its faculty. This is especially true in a college devoted to the training of mature men and women, many of whom are already employed in their chosen professions.

The instructional staff of Lincoln College is composed of professional academicians from Northeastern University and neighboring educational institutions and practicing professionals from the scientific and industrial community of Greater Boston. The theoretical training and practical experience represented by this combination of specialists are ideally suited to the technology programs they teach and the adult students they serve.

The faculty are selected for their ability and active interest in the welfare of ambitious part-time students. They are men and women of culture and high ideals, and are qualified by educational training and professional experience to teach effectively in their respective fields.

A staff of experienced professional educators who serve as program and course consultants constitutes the Academic Advisory Council and Curriculum Advisory Committee of the College. They guide, supervise, and assist with the administration of courses and programs.

The Faculty

The following is an alphabetical list of the faculty of Lincoln College; degrees earned; professional affiliation; and Lincoln College department (year of appointment).

Arnold M. Aaron, BS, MS, PhD
Engineer, Naval Underwater Systems Center
Electrical Engineering Technology (1974)

Velda Adams, BS, MS
Principal Engineer, Digital Equipment Corp.
Computer Technology (1980)

***Arnold W. Almquist, Jr., BS, MEd**
Mathematics Instructor, Needham High School
Mathematics (1967)

*Appointed to the rank of senior lecturer.

Peter Anderson, BS, MS
Senior Engineering Specialist, GTE Products Corp
Electrical Engineering (1976)

Robert P. Anderson
Computer Specialist, United States Department of Transportation
Computer Technology (1983)

***Robert B. Angus, Jr., BS, MS, PE (Mass.)**
Principal and Consultant, Angus Associates
Electrical Engineering Technology (1947)

Ramakanth V. Appalaraju, BS
Teaching Assistant, Northeastern University
Electrical Engineering (1983)

Alain Arnaud, BS, MS
Senior Design Engineer, Raytheon Co., Data Systems Division
Electrical Engineering (1982)

***Robert J. Averill, BS, MS**
President, Sala Magnetics, Inc.
Course Consultant, Electrical Engineering Technology (1957)

John C. Balsavich, AS
Laboratory Supervisor, Electrical Engineering, Northeastern University
Electrical Engineering Technology (1957)

Henry G. Barry, MEd
Department Chairman, Bigelow Junior High School, Newton, MA
Mathematics (1979)

Adolph Baumann, BS, PE (Mass.)
Telecommunications Engineer, GTE Sylvania
Electrical Engineering Technology (1955)

Peter L. Benoit, AE, BS
Senior Electrical Engineer, Polaroid Corp.
Computer Technology (1981)

***Matteo P. Berardi, BS, MSEIT (Mass.)**
Assistant Chief Engineer, Stone & Webster Engineering Corp.
Mechanical Engineering Technology (1960)

Maureen P. Berggren, BS
Lecturer, Quincy Junior College (Parttime)
Mathematics (1965)

Robert W. Berkstresser, BS, MS
Senior Engineer, Software, Raytheon Co.
Computer Technology (1981)

Wayne M. Bethoney, BET, BS
Mechanical Engineer, AMMRC
Mechanical Engineering (1982)

Ralph S. Blanchard, BSME, MSME, PE (Mass.)
Associate Dean, College of Engineering, Northeastern University
Associate Program Consultant, Mechanical Engineering Technology (1950)

***Robert E. Bobeck, AE, BS, MEd**
Professor, Bristol Community College
Engineering Graphics (1976)

***Edward Bobroff, BME**
Test and Start-up Manager, Cogeneration Management/Harvard University
Program Consultant, Mathematics (1946)

***Donald H. Breslow, SB, MS**
Director of Engineering, Measurement Systems Division, Itek Corp.
Electrical Engineering Technology (1959)

***Appointed to the rank of senior lecturer.**

***Donald C. Brock, BS, MS**

Mathematics Instructor, Needham High School
Mathematics (1965)

***Franklyn K. Brown, BSEd, MEd**

Associate Professor, Design Graphics, Northeastern University
Course Consultant, Engineering Graphics and Computation (1955)

Kip A. Brown, BS

Programmer/Analyst, United States Department of Transportation
Computer Technology (1982)

Jeffrey L. Bruce, BS, MA

Software Engineer, Raytheon Co., Missiles Division
Mathematics (1969)

***Morris H. Burakoff, BS, PE (Mass.)**

Consultant in Computer Technology, Self-employed
Computer Technology (1957)

Vincent K. Butler

Assistant Staff Manager, New England Telephone Co.
Computer Technology (1982)

***Leroy M. Cahoon, BSCE, MS, PE (Mass., Conn.)**

Associate Professor of Civil Engineering, Northeastern University
Program Consultant, Civil Engineering Technology (1962)

***Frank R. Cangiano, BS, EdM**

Instructor in Science and Mathematics, Medford High School
Mathematics (1957)

Joseph M. Cardito, BS, MS, PhD, PE (Mass.), CHP (American Board of Health Physics)

Supervisor, Nuclear Fuels and Data Systems, Stone & Webster Engineering Corp.
Mechanical Engineering Technology (1978)

Robert W. Case, PhD

Coordinator for Day Program, Lincoln College
Mathematics (1976)

***Walter J. Casey, AB, MEd, MAT**

Mathematics Teacher, Brighton High School
Mathematics (1955)

Paul Chicoine, ASET, BS

Development Engineer, Foxboro Co.
Computer Technology (1983)

J.T. Chen, MSEE, PhD

Senior Engineer, Digital Equipment Corp.
Computer Technology (1983)

Joan M. Chrusciel, BS, MEd, MA

Mathematics Teacher, Quincy High School
Mathematics (1980)

Vincent L. Cocco, BS

Senior Engineer, Polaroid Corp.
Mechanical Engineering Technology (1978)

Thomas C. Coleman, BSME, MSME, PhD, PE (Mass.)

Senior Project Engineer, Charles T. Main, Inc.
Course Consultant, Mechanical Engineering Technology (1960)

Robert P. Collins, BS, MEd, DEd

Grants Coordinator, Boston Public Schools
Mathematics (1981)

Wendell R. Collymore

Electronic Engineering Design CAD/CAM, Polaroid Corp.
Engineering Graphics (1976)

*Appointed to the rank of senior lecturer.

Leonard M. Conlin, AB, EdM
Mathematics Teacher, Framingham North High School
Mathematics (1967)

***Roger T. Connor, AB, MEd**
Teacher, Milton Academy
Course Consultant, Calculus (1953)

***Robert J. Connors, BS**
Manager of Technology, Sylvania Electric Products, Inc., Electronic Systems Division
Electrical Engineering Technology (1948)

***Joseph Z. Cooper, BSEE**
Principal Engineer, Raytheon Co.
Computer Technology (1967)

***James B. Corscadden, BS, MEd, AMT**
Assistant Headmaster, South Boston High School
Mathematics (1967)

William L. Crenshaw, BSME, MSME, PE (Mass.)
Research Mechanical Engineer, Army Materials and Mechanics Research Center
Mechanical Engineering (1980)

David C. Crockett, BS, MS
Senior Engineer, Raytheon Co.
Mechanical Engineering Technology (1969)

Steven S. Cushman, BS, PhD
Software Consultant
Computer Technology (1977)

Gregory Czarnowski, AB, MA
Advertising Executive, Auld Associates
Technical Communications (1982)

Charles A. DeAngelis, BS, MS, PE (Mass., Ind.)
Senior Structural Engineer, Stone & Webster Engineering Corp.
Civil Engineering Technology (1976)

Robert DeFreitas, AS, BS, MS
Group Leader, Raytheon Co., Equipment Division
Computer Technology (1982)

Joseph N. Demusz, BS, MS
Lecturer, Harvard University
Electrical Engineering (1983)

***Thomas R. Deveney, BS, MA**
Manager, Boston Public Schools
Mathematics (1965)

Jane E. DeVoe, BS, MA
Lecturer in Mathematics
Mathematics (1980)

Douglas H. Diamond, BEE, MS
Program Manager, Analytical Systems Engineering Corp.
Mathematics (1968)

Raffaele Di Cecca, BA, MA, MA
Assistant Professor, Wentworth Institute of Technology
Mathematics (1982)

Nicola DeIorio, BS, MS
Senior Engineer, Communications Division, GTE Sylvania
Computer Technology (1983)

***Giles C. Dilg, BSEE, MSEE, PE (Mass.)**
Manager, Honeywell Information Systems
Engineering Graphics (1966)

***Appointed to the rank of senior lecturer.**

***Mark Domaszewicz, BEE, MSEE**
Senior Engineer, Raytheon Co.
Mathematics (1970)

***Leonard F. Dow, BSEE, MS, PE (Mass.)**
Staff Engineer, Boston Edison Co.
Electrical Engineering Technology (1970)

Philip W. Dunphy, BSc, MEd
Associate Professor, Cooperative Education, Northeastern University
Academic Counselor (1967)

David P. Durant, BS, MEd, MS
Teacher, City of Boston
Mathematics (1983)

***William V. Durante, BS, MEd, MA**
Assistant Headmaster of Mathematics, Boston Latin School
Course Consultant, Mathematics (1964)

Henry B. Eden, BS
President Anco Boston, Inc.
Engineering Graphics (1957)

Adolf J. Erikson, BBA, MBA, PE (Mass.)
President, A.E. Engineering Corp.
Engineering Graphics (1966)

Gordon C. Estabrooks, AB, MA, MEd
Physics Instructor, Boston School Department
Physics (1983)

Andreas L. Evriviades, BS, MA
Teacher of Mathematics, Milton Academy
Mathematics (1983)

Thomas C. Fantasia, MSEE, BSEE
Electrical Engineering, Boston Edison Co.
Electrical Engineering Technology (1981)

Edwin H. Farr, BS, MS, PhD
United States Dept. of Transportation
Mathematics (1980)

***William D. Finan, AB, MA, DEd**
Reading Director, Needham Public Schools
Course Consultant, Mathematics (1946)

***Louis A. Fiore, AE, BBA**
Chief Draftsman, American Science and Engineering, Inc.
Engineering Graphics (1956)

John M. Flaherty, BS, MS, PhD
Engineering Specialist, GTE Sylvania
Electrical Engineering Technology (1976)

James J. Flannery, BSEE, MSEE, PE (Mass.)
Division Head, Engineering Computer Applications, Boston Edison Co.
Power Systems (1980)

John J. Fraizer, BS
Senior Engineer, Raytheon Co.
Physics (1981)

Lewis J. Fusegni, BSME, MSME
Senior Power Engineer, Stone & Webster Engineering Corp.
Mechanical Engineering (1983)

Kenneth Gagnon, BS
Lecturer in Chemistry, Northeastern University
Physics (1983)

***Appointed to the rank of senior lecturer.**

***Peter D. Gianino, BS, MS**

Research Physicist, R.A.D.C., Hanscom Air Force Field
Course Consultant, Differential Equations (1980)
Mathematics (1965)

Sheldon L. Glickler, BS, MS

Program Manager, G.C.A. Corp.
Mechanical Engineering Technology (1969)

***David Goldberg, BS, MSEE, MSEM**

Program Manager, GTE Sylvania
Course Consultant, Engineering Graphics (1969)

Bernard F. Goldstein, BS, MS, PhD

Senior Analyst, Dynamics Research Corp.
Electrical Engineering Technology (1974)

W. Dale Hall, PhD

Member, Technical Staff, MITRE Corp.
Mathematics (1981)

Philip R. Haberstroh, BSEd, MSED

Teacher of Mathematics, Boston Latin School
Mathematics (1981)

***Francis R. Hankard, SB, MA**

Assistant Chief of Lab., Mass. Department of Public Safety
Program Consultant, Physics (1946)

Howard Hill

Teacher of Mathematics, Needham High School
Mathematics (1982)

Lewis H. Holzman, BSCE, SMCE, PE (Mass.), RLS (Mass.)

Consultant, Computer Department, Stone & Webster Engineering Corp.
Computer Technology (1966)

C. Gregory Hood, BS, MA, PhD

Newton Public Schools
Physics (1975)

Udo Hoppenz, BS, MS

Associate Professor of Physics, Wentworth Institute of Technology
Mathematics (1979)

Charles E. Jacob, BSEE, MSED, MLS

Master, Boston Latin School
Physics (1967)

***Arthur W. John, BSEE, MS, MBA**

Training & Development Manager, Mgmt. & Org. Development Corp., Data General Corp.
Physics (1968)

Eugene F. Joyce

Technician Electrical Engineering Dept., Northeastern University
Electrical Engineering Technology (1963)

John Joseph Joyce, BS, MEd, MA

Teacher of Mathematics, Winchester High School
Mathematics (1983)

***John Kaczorowski, Jr., BSEE, MSEE**

Dean of External Programs, Wentworth Institute of Technology
Associate Program Consultant, Electrical Engineering Technology (1970)

Phillip T. Karatzas, AE, BS, MS

Senior Radiological Engineer, Boston Edison Co.
Physics (1978)

***Leon Katler, Certificate PE (Mass., Maine, N.Y., Penn., Va.)**

Consultant, Structural Engineering, Self-employed
Civil Engineering Technology (1963)

***Appointed to the rank of senior lecturer.**

***Louis Katona, BCE, MCE, PE (Mass., N.Y.)**
Senior Hydraulic Engineer, Badger America, Inc.
Civil Engineering Technology (1959)

John G. Kelly, BS
Computer Specialist, William M. Mercer, Inc.
Computer Technology (1982)

Marcia Kemen, BA, MEd
Assistant Professor of Math., Wentworth Institute of Technology
Mathematics (1983)

***George F. Kent, BS, MS, MBA, PE (Mass., Conn.)**
Department Manager, Continuing Education
Course Consultant, Materials (1962)

Bernard J. Kiley, BE, ME, PE (N.H., Mass., Conn.)
Senior Structural Engineer, Stone & Webster Engineering Corp.
Mechanical Engineering Technology (1958)

***John J. Klein, BS, MS**
Manager, Design Engineering, RCA
Electrical Engineering Technology (1950)

Joseph C. LaCroix, BA, MEd, CAGS
Chairman, Mathematics Department, Dorchester High School
Mathematics (1974)

Peter P. LaGrassa, BSIT
Senior Engineer, Information Systems Div., Honeywell, Inc.
Electronics Industrial Technology (1982)

***Robert S. Lang, BS, EdM**
Associate Professor, Engineering Design Graphics, Northeastern University
Course Consultant, Engineering Graphics (1955)

Stephen E. Lemmo, AS, BS
Computer Applications Engineer, Stone & Webster Engineering Corp.
Computer Technology (1983)

Alvin J. Lesieur, BET, BS, MEd
Instructor, Instron Corp.
Engineering Graphics (1965)

***Sandra M. Lictor, BS, MS, CS, MEd**
Software Engineer, Raytheon Co.
Mathematics (1967)

***Demetre P. Ligor, BSEE, PE (Mass.)**
President, Applied Measurements, Inc.
Course Consultant, Physics (1959)

Warren J. Little, BS, MS
Technical Staff, Charles Stark Draper Labs., Inc.
Physics (1966)

George M. Livingstone, Jr., BS
Private Practice
Civil Engineering Technology (1975)

Bertram S. Long
Associate Professor Mechanical Engineering, Northeastern University
Associate Program Consultant, Mechanical Engineering Technology (1975)

***Roger G. Long, AE, BBA, PE (Mass.)**
Senior Staff, Arthur D. Little, Inc.
Electrical Engineering Technology (1952)

***Kenneth A. Lucas, BS, MEd, PE (Mass.), RLS (Mass., Maine, N.H.)**
President, Mass. School of Survey, Inc.
Civil Engineering Technology (1950)

***Appointed to the rank of senior lecturer.**

John F. Lutkevich, AE, BBA
Engineer-in-Charge, GTE Sylvania
Engineering Graphics (1956)

***Jack I. Mann, BS, MS, PE** (Mass., Vt., Penn., Conn., Wyo., Ind., Ohio, Va., Tenn., N.H., N.J., W.Va.)
Structural Engineer, United Engineers & Constructors, Inc.
Mechanical Engineering (1961)

Anton Mavretic, BS, MS, PhD
Associate Professor, Boston University
Associate Program Consultant, Electrical Engineering Technology (1969)

Michael V. McAulay
Manager of Advertising and Public Relations Department, H4P Co.
Technical Communications (1980)

James H. McCaffrey, AE, BEE, BSIE
Engineering Scientist, Technical Staff, GCA Corp.
Engineering Graphics (1982)

***Edward McCarren, Jr., AE**
Product Engineer, Analog Devices, Inc.
Electrical Engineering Technology (1951)

***Carl J. Mellea, SB, MS, PE** (Mass., R.I., Maine, Vt., N.H.)
Project Engineer; Howard, Needles, Tammen & Bergendorff
Civil Engineering Technology (1960)

Robert L. Meserve, BS, MS
Associate Professor, Civil Engineering, Northeastern University
Civil Engineering Technology (1978)

***Walter Messcher, BME, MS**
Project Manager, United States Department of Transportation
Program Consultant, Computer Technology (1966)

Richard W. Miller, BS, MS, PE (Mass.)
Principal Research Engineer, The Foxboro Co.
Mechanical Engineering Technology (1959)

***Ernest E. Mills, BS, MS, PE** (Mass.)
Program Coordinator of Mechanical Engineering Technology and Associate Professor of Mechanical Engineering Technology
Lincoln College, Day and Evening Programs (1946)

Marven A. Mishkin, BS, MS, ME
Systems Engineer, Computervision Corp.
Mechanical Engineering (1982)

Louis A. Moore, AE, BET, BSCE, RLS (Mass.)
Chief Engineer, Commonwealth of Mass., Land Court, Boston
Civil Engineering Technology (1972)

Steven R. Munroe, BS
Computer Systems Engineer, Arron Electronics
Computer Technology (1981)

***Louis J. Nardone, BS, MS, PE** (Mass.)
Associate Professor, Electrical Engineering Technology, Northeastern University
Program Coordinator for Electrical Engineering Technology
Lincoln College, Day and Evening Programs (1955)

***Ray O. Oglesby, BSEd, MEd**
Teacher, Newton North High School
Mathematics (1967)

***Yesugey Oktay, BS, MS, PE** (Mass., N.Y., Calif., Maine)
Division Head, Mechanical & Structural Engineering, Boston Edison Co.
Civil Engineering Technology (1970)

Douglas J. Ordway, BA, MEd
Teacher, Boston Public Schools
Mathematics (1975)

*Appointed to the rank of senior lecturer.

Wm. Michael O'Steen, BSIE
Project Training Coordinator, Stone & Webster Engineering Corp.
Technical Communications (1981)

***Thomas J. Owens, AB, MEd**
Instructor in Mathematics, Quincy High School
Mathematics (1952)

John P. Page, AB, MEd, AM
Teacher of Mathematics, Boston Latin School
Mathematics (1980)

***William H. Parmenter, AE, BBA**
Retired
Electrical Engineering Technology (1952)

Francis A. Pepicelli, AE, BS
Engineer, Northrop Corp.
Mechanical Engineering Technology (1976)

Robert J. Perfetto, AS, BS, MEd
Occupational Coordinator, Dimin Regional Vocational Technology
Engineering Graphics (1983)

William K. Perkins, BSEE
Senior Technical Writer, Codex Corp.
Technical Communications (1980)

Walter J. Phinney, AE, BET, MBA
Manager, Product Design, Raytheon Co.
Mechanical Engineering Technology (1977)

Dominic A. Piccione, BS, MSPE (Mass., Va.)
Senior Engineer, Stone & Webster Engineering Corp.
Mechanical Engineering Technology (1966)

Richard H. Pike, BSIE, MBA
Management Consultant, Self-employed
Industrial Engineering (1980)

Robert F. Poe, BS, BA, MS, PhD
Scientist, Eikonix Corp.
Computer Engineering Technology (1980)

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Research Associate, Northeastern University
Electrical Engineering Technology (1966)

Donald J. Poulin, AE, BSIT, PE (Mass.)
Sr. Test Eng., Kollsman Institute
Electrical Engineering Technology (1970)

***Daniel W. Pratt, BS, MS**
Director of Computer Science, Boston Latin School
Mathematics (1967)

***Charles H. Price, Jr., BSEE, MSEE**
Technical Staff, MITRE Corp.
Course Consultant, Electrical Engineering Technology (1960)

James F. Regan, BSCE, MSCE, PE (Mass.)
President, Keefe & Regan Engineers, Inc.
Civil Engineering Technology (1972)

***Edward L. Rich, BS, MS, PE (Mass.)**
Program Control Manager, Raytheon Co.
Mechanical Engineering Technology (1956)

Edward Ricupero, AB, MEd
Head of Mathematics Department, Everett High School
Mathematics (1983)

***Appointed to the rank of senior lecturer.**

Robert J. Ritchie, AE, BS
Computer Graphics Supervisor, Boston Edison Co.
Engineering Graphics (1980)

Robert Rosenberg, SB, SM, ScD
Engineering Consultant, Stone & Webster Engineering Corp.
Mechanical Engineering (1983)

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Instructor, Archdiocese of Boston
Mathematics (1967)

G. Michael Rubalcaba, BA
Associate Engineer, Raytheon Co.
Mathematics (1982)

Thomas E. Ruden, BS, MS
Physicist, Varian Associates, Inc.
Physics (1967)

Janis Rumba, BS
Structural Engineer, Charles T. Main, Inc.
Mechanical (1982)

***Leo D. Salvucci, AB, MEd, MST**
Mathematics Teacher, Boston Latin School
Mathematics (1965)

Annino Salvucci, Drafting Certificate, AE
Equipment Design Engineer, Honeywell, Inc.
Engineering Graphics (1983)

Mehrdad Sheikholeslami, BSEE, MSEE
Senior Member of Technical Staff, Telelogic, Inc.
Electrical Engineering (1981)

***Walter S. Shields, BS, EdM, MS, MEd**
Mathematics Instructor, Needham Public Schools
Mathematics (1966)

Melvin W. Simms, MBA, EdM, EdD
Assistant Professor and Coordinator, Northeastern University
Mathematics (1983)

Ronald Skilton, BS
Computer Specialist, Stone & Webster Engineering Corp.
Computer Technology (1983)

John M. Slepetz, BCE, PhD, PE (Va.)
Research Civil Engineer, United States Materials and Mechanics Research Center
Mechanical Engineering Technology (1970)

***Benjamin R. Stahl, BA**
Senior Systems Analyst, Raytheon Data Systems Co.
Computer Technology (1966)

***Joseph E. Steffano, Sr., BS, MS, MBA, PE (Mass., Vt., N.H., Conn., Maine, R.I., N.Y., Penn.), RLS (Mass., Conn., N.H., Maine, R.I., Vt.)**
Chief Engineer, Stone & Webster Engineering Corp., Structural Division
Civil Engineering Technology (1965)

Harold J. Stengel, SB
Secondary Teacher in Mathematics, Boston Latin Academy
Mathematics (1982)

***M. Carlton Storms, BA, MEd**
Teacher, Braintree High School
Physics (1967)

***Raimundas Sukys, BS, MS**
Senior Research Associate in Electrical Engineering, Northeastern University
Course Consultant, Electrical Engineering Technology (1962)

***Appointed to the rank of senior lecturer.**

Eligijus S. Suziedelis, BS, MEd
Department Head—Mathematics, East Junior High School
Electrical Engineering (1982)

David G. Sveden, BA, MEd
Math Instructor, Town of Needham
Mathematics (1979)

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Teacher, City of Lynn
Physics (1968)

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Chief Electrical Engineer, ARK-LES Corp.
Electrical Engineering Technology (1982)

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Professor, Bunker Hill Community College
Mathematics (1956)

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Research Associate, Boston University
Electrical Engineering (1983)

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Software Engineering, RCA—Automated Systems
Computer Technology (1981)

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Advanced Research and Development Engineer, GTE Sylvania
Computer Technology (1981)

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Marketing Manager, EG&G
Mechanical Engineering Technology (1968)

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Senior Engineer, Raytheon Co.
Electrical Engineering Technology (1965)

Uri Tsach, PhD
Engineer, Stone & Webster Engineering Corp.
Electrical Engineering (1982)

Wai L. Tsang, BS, EE, MSEE, PhD, EE
Research and Development Engineer, GTE Sylvania
Electrical Engineering (1982)

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Systems Programmer, Stone & Webster Engineering Corp.
Computer Technology (1983)

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Manager, Instrument Standards and Controls, General Electric Co.
Physics (1968)

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Manager, Metallurgical Engineering, Badger Engineering, Inc.
Mechanical Engineering (1981)

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Senior Engineer, The Foxboro Co.
Computer Technology (1977)

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Development Engineering Group Leader, BLH Electronics
Physics (1979)

***Willard B. Whittemore, BSCE, EdM, CAGS**
Director of Mathematics, Everett Public Schools (Retired)
Mathematics (1957)

*Appointed to the rank of senior lecturer.

***Joseph F. Willard, BS, PE (Mass.), RLS (Mass.)**
Associate Civil Engineer, Massachusetts Department of Public Works
Civil Engineering Technology (1949)

***Albert G. Wilson, BS, MS, PE (Mass.), SE (Ill.)**
Structural Engineer, Stone & Webster Engineering Corp.
Course Consultant, Mechanical Engineering Technology (1948)

Robert M. Wilson, BSEE, M/EE
Group Leader, Codex Corp.
Computer Technology (1982)

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Associate Professor, Design Graphics, Northeastern University
Aerospace Adviser, Lincoln College
Academic Counselor (1967)

Elliot Wyner, BS, MS, PhD
Research Engineer, GTE Sylvania
Physics (1973)

Walter Zagieboylo, MS, ME, PE (Mass.), MAA
Town Appraiser and Assessor, Wrentham, Mass.
Mathematics (1969)

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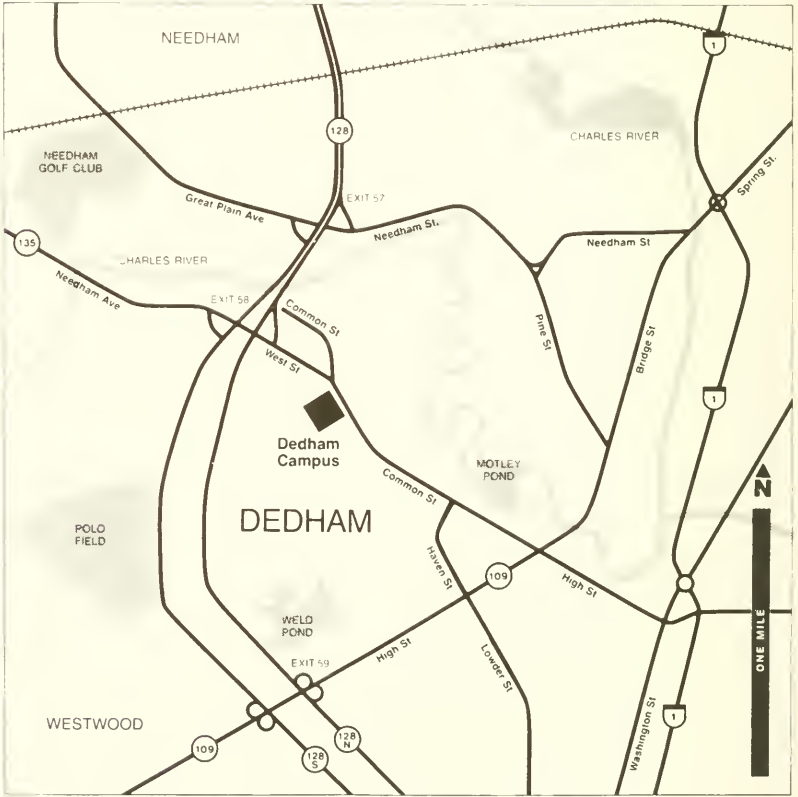
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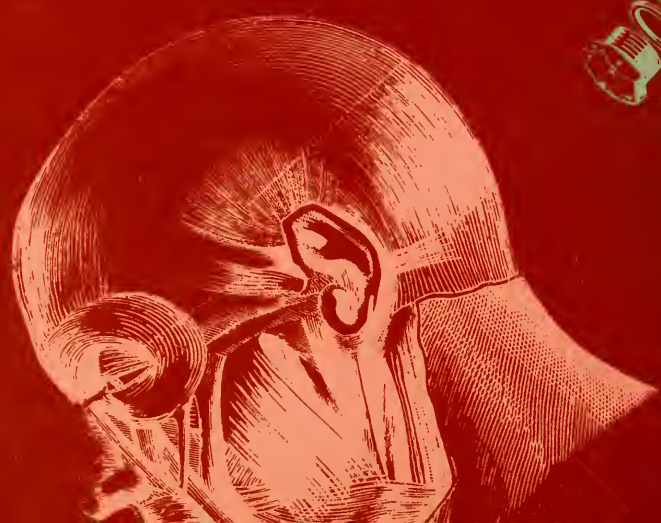
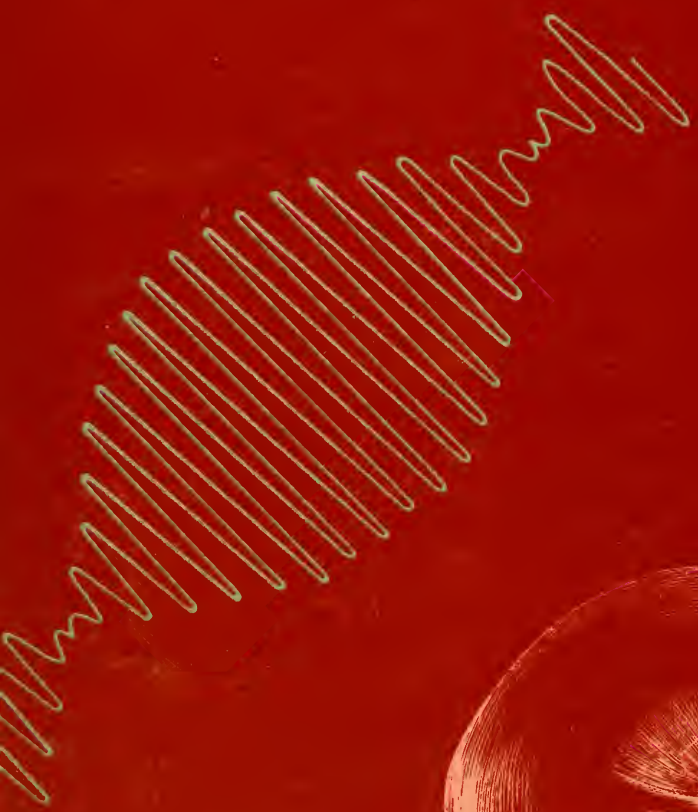
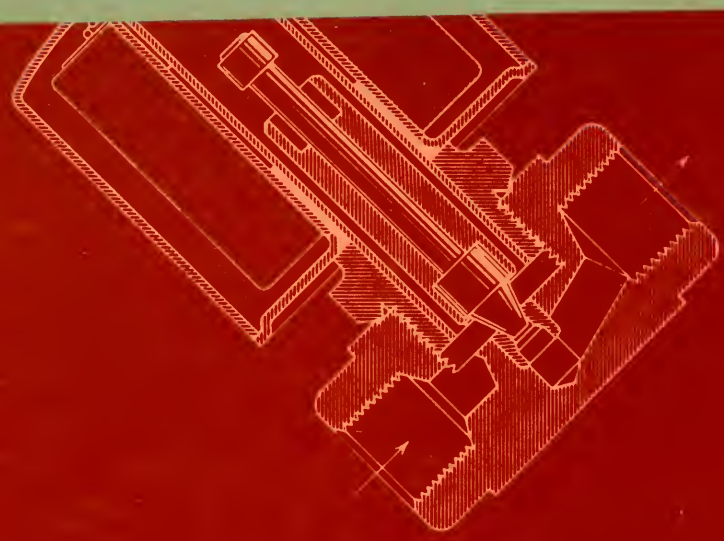
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Graduate Schools Course Descriptions



Northeastern University

1984–85

Graduate Schools Course Descriptions

Arts and Sciences

Boston-Bouvé College

of Human Development Professions

Professional Accounting

Computer Science

Criminal Justice

Engineering

Pharmacy and Allied Health Professions

Northeastern University charges tuition for all courses taken above the normal academic load.

The University reserves the right to make changes in the regulations and courses announced in this bulletin.

**Northeastern
University Publications
4.11.4**

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Northeastern will do its best to make available to you the finest education, the most stimulating atmosphere and the most congenial conditions it can provide. But the quality and the rate of progress of your academic career is in large measure dependent upon your own abilities, commitment, and effort. This is equally true with respect to professional advancement upon completion of the degree or program in which you are enrolled. The University cannot guarantee that you will obtain or succeed at any particular job; that will depend upon your own skills, achievement, presentation and other factors such as market conditions at that time. Similarly, in many professions and occupations there are increasing requirements imposed by federal and state statutes and regulatory agencies for certification or entry into a particular field. These may change during the period of time when you are at Northeastern and they may vary from state to state and from country to country. While the University stands ready to help you find out about these requirements and changes, it is your responsibility to initiate the inquiry because the University has no other way of knowing what your expectations and understandings are.

In brief, the University is there to offer you educational opportunities and choices and to assist you in finding the direction in which you want to steer your educational experience, but you are a partner in this venture with an obligation and responsibility to yourself.

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Northeastern University is committed to a policy of equal opportunity for all students and employees without regard to race, color, religion, sex, sexual preference, national origin, or handicap or veteran status. The University prohibits discrimination in all matters involving admission, registration, and all official relationships with students, including evaluation of academic performance.

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Accreditation Statement

Northeastern University is accredited by the New England Association of Schools and Colleges, Inc., which accredits schools and colleges in the six New England states. Accreditation by the Association indicates that the institution has been carefully evaluated and found to meet standards agreed upon by qualified educators.

Tuition rates, all fees, rules and regulations, courses and course content are subject to revision by the President and the Board of Trustees at any time.

The following is a list of courses offered by the graduate schools of Arts and Sciences, Boston-Bouvé College of Human Development Professions, Criminal Justice, Computer Science, Engineering, Pharmacy and Allied Health Professions, and Professional Accounting for the academic year 1984–1985.

To obtain course listings for the schools of Business and of Law, please refer to their respective catalogues.

In order to register for courses outside one's graduate school, students *must* meet the requirements of the school offering the course(s) as well as their home school.

Students may not register for any courses outside their school unless the appropriate permit is presented at registration. Consult your graduate school office for details concerning these procedures.



Arts and Sciences

Arts and Sciences

Anthropology and Sociology

All courses carry three quarter-hours of credit unless otherwise specified.

Social Anthropology

Many undergraduate courses in the SOA 300 and 400 series may be offered for graduate credit. Students should check the current course announcements to take advantage of these offerings.

SOA 3100 Theory 4 Q.H.

History of major contemporary orientations: evolutionary approaches, culture area, cultural ecology, functionalism, structuralism, and analysis of current status of these and related theories.

SOA 3101 Human Origins 4 Q.H.

An examination of the data on fossil remains and on contemporary primates which are essential for understanding human physical and behavioral evolution.

SOA 3102 Evolution of Society 4 Q.H.

The development of political and economic institutions beginning with foraging societies and the sexual division of labor: specialization, social stratification and the emergence of civilization.

SOA 3120 Visual Anthropology

Explores the anthropologist's use of film to gather information and analyze cultural subsystems. In addition to reading about and viewing films on particular populations, students are introduced to the field through a laboratory aspect of the course involving the use of tape and video equipment.

SOA 3121, SOA 3122 Fieldwork I, II

4 Q.H. each

Data collection through participant observation and related anthropological methods. Data analysis and reports. (Not offered in years in which SOC 3120 and SOC 3121 are offered.)

SOA 3135 Language and Communication

Human communication, including language. Theories of the evolution of language and the application of models derived from the study of language to other aspects of behavior.

SOA 3145 Peasants

Institutions of peasant society. The structure of traditional civilizations and the interrelations between urban and local communities: comparative and functional analysis of the peasant community and the dynamics of change from peasant to post-peasant and industrialized societies.

SOA 3155 Individual and Culture

Examination of current theory and method in the study of the interplay between personality and culture. Contributions by various disciplines are discussed.

SOA 3156 Family in Evolutionary Perspective

4 Q.H.

The emergence of family from prehuman patterns, its biological and behavioral components, and its cross-cultural variations examined from an evolutionary perspective.

SOA 3185 Aggression

Concepts of aggression as they have been used in evolutionary and comparative anthropological formulations. Professional and popular publications in anthropology, ethology, and psychology are analyzed.

SOA 3220 Culture and Mental Illness

Discussions and analyses of the nature and meaning of culture, the role of culture in personality formation, culture and anxiety, anthropological approaches to the normal and the "abnormal," and the question, "Is mental illness psychological fact or cultural fiction?"

SOA 3265 Anthropology of Religion

Nature and institutionalization of primitive, ancient, and contemporary religions. Exploration of religious concepts and movements in relation to social, religious, and political organization.

SOA 3275 The Anthropology of Music

The examination of music in a prehistoric and cross-cultural perspective, with emphasis on ethnomusicology and the comparison of Western and non-Western musical culture. Functions and social contexts of musical composition and performance; the ethnography of musical performance groups, the analysis of music as a form of communication.

SOA 3300 Cultural Ecology

Examines human adaptation to environment and the effect of different human adaptations on natural systems.

SOA 3310 Social Change and Economic Development

Selected studies of processes of transformation and modernization in nonindustrial societies.

SOA 3345 Urban Ethnography

Selected problems in anthropological studies in urban societies.

SOA 3355 The Anthropology of Law and Conflict

Settling disputes in stateless societies; forms and mechanisms of social control; law as an indicator of cultural and social norms; the study of conflict resolution as an ethnographic tool. Some field research and analysis is required.

SOA 3360 Economic Anthropology

Types of economic systems in simple societies: reciprocal, redistributive, market exchange; economic relations as part of social relations; land-tenure systems, credit systems, savings mechanisms. The transition from subsistence to cash economics.

SOA 3410, SOA 3411, SOA 3412, SOA 3413

Contemporary Issues in Social Anthropology

3 Q.H. each

Contemporary issues in the field of anthropology. Supervised readings and written reports on special programs.

SOA 3420 Kinship and Social Structure

A variety of kinship systems and their terminological and structural components and the way in which their systems articulate with other social institutions.

SOA 3425 Tribal Societies and Culture

The structures and institutions of bands, tribes, and chiefdoms: comparative and functional studies of tribal societies and the dynamics of change under contact situations.

SOA 3440, SOA 3441, SOA 3442, SOA 3443,

SOA 3444, SOA 3445

Ethnographic area courses (New World Indian, African, Indian, Chinese, and others) are offered as resources permit.

SOA 3600, SOA 3601, SOA 3602 Seminar

3 Q.H. each

Discussion of selected topics in the field of anthropology.

SOA 3798 Master's Thesis Continuation 0 Q.H.

SOA 3800, SOA 3801, SOA 3802 Directed Study in Social Anthropology

Maximum: 9 Q.H.

Reading and empirical research in social and cultural anthropology supervised by members of the anthropological staff.

SOA 3810 Master's Paper in Social

Anthropology

6 Q.H.

Empirical or library research meeting the criteria for publication in a professional journal. *Supervision by members of the department.*

Sociology

Many undergraduate courses in the SOC 300 and 400 series may be offered for graduate credit. Students should check the current course announcements to take advantage of these offerings.

SOC 3100 Foundations of Social Theory I

4 Q.H.

The classic theorists (Durkheim, Weber, Marx, Simmel, and others) are considered intensively.

SOC 3101 Foundations of Social Theory II

4 Q.H.

An intensive analysis of modern theorists from the 1930s onward (Parsons, Merton, Levi-Strauss,

Goffman, Homans, Schutz, Garfinkel, Ricoeur, Lukacs, Habermas, and others). The social and historical context of theory construction is stressed.

SOC 3103 American Society

Study of the development of, and the changes in, the institutional structure of American society in comparison with certain other social systems.

SOC 3113 Introduction to Research Methods

2 Q.H.

An introduction to methods of social research including field study and participant observation techniques, survey techniques, interviewing and questionnaire construction, sampling procedures, experimental design, content analysis, and uses of available data. *Open only to law, policy and society students.*

SOC 3114 Introduction to Quantitative

Research Methods

2 Q.H.

An introduction to quantitative techniques of analysis. Students are expected to conduct individual research projects. *Open only to law, policy and society students. Prereq.: SOC 3113 or equivalent.*

SOC 3115 Statistical Methods for Sociologists

4 Q.H.

Detailed introduction to statistical methods relevant to sociology. Topics include tabular analysis, nonparametric statistics, analysis of variance, regression analysis, path analysis, measures of association, estimation and univariate and multivariate hypothesis testing. A knowledge of elementary statistical theory is presumed.

SOC 3116 Introduction to Research Methods

4 Q.H.

A survey of methods of social research including field study and participant observation techniques, survey techniques, interviewing and questionnaire construction, sampling procedures, experimental design, content analysis, and use of available data.

SOC 3117 Quantitative Research Methods

Quantitative techniques of analysis. Students are expected to conduct individual research project. *Prep.: SOC 3116 (or equivalent) or consent of the instructor.*

SOC 3120, SOC 3121 Seminar in Qualitative Analysis I, II

4 Q.H. each

Qualitative techniques of analysis. Social-structure process and meaning in interacting groups. Each student is expected to study a face-to-face group by means of participant observation using symbolic interaction concepts. *(Not offered in years in which SOA 3121 and SOA 3122 are offered.)*

SOC 3125, SOC 3126, SOC 3127 Proseminar

1 Q.H. each

This course is suggested for entering students. The focus is on issues related to graduate student

life and expectations, professional and career choices, and works in progress. Students have an opportunity to explore more informally, with each other and with various faculty members, some of the important issues in the profession.

SOC 3135 Issues in Social Psychology

Human behavior and theories of self from a sociological and psychological perspective. Special consideration of interpersonal relations, socialization, and symbolic interaction.

SOC 3140 Sociology of Prejudice and Discrimination

A study of the characteristics, causes, and consequences of prejudice and discrimination, with particular reference to American society.

SOC 3147 Urban Sociology

Theories of the development of urban life. Comparisons between preindustrial and industrialized urban areas. Methods for the study of urban social structure and change. Evaluation of contemporary metropolitan action programs.

SOC 3148 Boston Seminar

A case study in urban development, including the evaluation of environmental and historical circumstances, demands for services, response to events, programs. Basis for value systems of Yankees, ethnics, and cosmopolitans. Impact on downtown and neighborhood relations. Metropolitan prospects.

SOC 3149 Metropolitan and Regional Issues

Comparative analyses of problems, policies, programs, and activities associated with metropolitan and regional life. Includes assessment of values, institutions, networks, interest groups, decision making, service delivery, growth and development, environment, equity, and integration. Case studies in societal context.

SOC 3155 The Family

Social structure and social functions of the family as a social institution. Relations between the family and other institutions in society are examined comparatively and historically.

SOC 3160 Women, Men, and Social Change

The Industrial Revolution and the corresponding changes in the labor force and patterns of domestic life have altered the sexual division of labor. In postindustrial society new institutional forms are recasting personal relations. The course examines these forces of social change and their impact on sex roles.

SOC 3165 Sociology of Education

The structure and functioning of educational institutions. Student, faculty, and administrative perspectives. Emphasis is placed on the role of education in processes of socialization, social mobility, social change, and social control.

SOC 3166 Sociology and Anthropology in the Schools

4 Q.H.

(Listed as ED 3322 in the Boston Bouvé Graduate School catalog) The course offers a setting in which current and prospective teachers of sociology and anthropology at the precollege and community college levels have the opportunity to analyze curricula in their fields and consider alternative rationales for various approaches to teaching sociology and anthropology at these levels. Study also focuses on the potential uses of sociological and anthropological concepts in analyzing and solving educational problems. Students are expected to present either a course or unit they have prepared or a project they have planned or conducted utilizing a sociological or anthropological perspective.

SOC 3170 Intergroup Relations

The relations between various racial, national, cultural, and religious groups with emphasis on historical development. Particular attention is paid to American society with its specific problems of adjustment and assimilation.

SOC 3171 Race and Ethnic Relations: A World Perspective

Cross-cultural analysis of race and ethnic relations in Western and non-Western societies. Explanations of race and ethnic relations in terms of contemporary developments, world problems, and ideological conflicts.

SOC 3175 Sociology of Work

The course is designed to examine the effects which the social organization of work has on the lives of workers as well as on the structure of society.

SOC 3176 Sociology of Occupations and Professions

The relations between the occupations and professions and society. Special topics may include occupational stratification, professional group behavior, recruitment and socialization of occupations and professions, and political activism.

SOC 3185 Sociology of Deviant Behavior

Applications of sociological concepts and principles to some problems of social disorganization in industrial societies. Analysis of such problems as suicide, prostitution, physical handicaps, unemployment, alcoholism, sexual deviance, and gambling.

SOC 3186, SOC 3187 Social Control I, II

Seminar in research, theories, and methods in the sociology of social control.

SOC 3190 Sociology of Delinquency

Social and social psychological factors of delinquency and their implications for prevention, rehabilitation, and treatment.

SOC 3200 Sociology of Alcoholism

The course examines four general problem areas: the conditions under which people categorize others as alcoholics; the processes by which persons so defined are assigned deviant status and assume appropriate roles and self-images as alcoholics; the development of drinking careers and their relationship to deviant subcultures; and the social situations in which people transform their deviant identities as alcoholics. The course applies organizational analysis to the development and changing network of alcoholism treatment services and tries to develop some tentative generalizations on the social organization of alcoholism.

SOC 3205 Sociology of Crime and Justice

A sociological and legal analysis of the criminal justice system, concentrating on police and law enforcement; plea-bargaining; courtroom research and trial strategies; sentencing; and prisoners' rights and corrections. The relationship between race, social class, and crime is also considered, as are the sociological explanations of crime causation.

SOC 3206 Sociology of Law

Fundamentals of law. The concept of social control. Order and law. Consensus and conflict. Analysis of the normative-formative influences of law. Mores and morals. The concept of justice. Analysis of some legal institutions.

SOC 3215 Sociology of Medicine

Social aspects of illness and medicine, historically and cross-culturally. Illness and the medical profession in modern society and their structural settings: the community, the hospital, the medical school. Research studies in the field are examined critically and problems for future research specified.

SOC 3225 Sociology of Aging

A critical examination of the field of social gerontology, the nature and roots of ageism and topics such as elderly housing, life study, institutionalization, health care, retirement, leisure, and senior power.

SOC 3226 Processes of Aging

Socioeconomic and social psychological consequences of aging are examined from the perspective of health-care providers. A major part of the course focuses directly on the biological changes entailed in aging and the appropriate medical management of geriatric patients. Open to students expected to provide health-care services to geriatric patients.

SOC 3240 Formal Organizations:

Administration and Structure

Analysis of the goals and functions of modern organizations. Aspects of bureaucratization are examined within business firms, public institutions, and private associations.

SOC 3245 Sociology of Poverty

An analysis of sociological perspectives on causes of poverty, public views on poverty, and institutional responses to poverty. A concern with policy issues and implementation of policies is emphasized. For advanced students in the social sciences and in the various human service schools in the University.

SOC 3275 Sociology of Art

Examination of the practices which lead to the production of artistic meaning; the relationship of art to society; the nature of artistic communities, their relationship to patronage systems and art markets; the manner in which these systems are rooted in particular social and historical contexts.

SOC 3276 Popular Culture

Both pluralist and mass culture theories are inadequate in explaining mass popular culture; therefore, a primary objective of the course is to develop and refine an efficient theoretical framework. Problems to be addressed include the relationship between popular culture, high culture, and folk culture and the genesis and role of the mass media in industrial societies. The course also focuses on empirical research in several forms of popular culture, including sports, rock music, and science fiction novels. Organization and impact of market, stylistic shifts, and the viability of criticism are examined.

SOC 3286 The Sociology of Science

Selected topics dealing with interactions between science and society.

SOC 3300 Contemporary Sociological Theories

Analytic treatment of major contemporary theories such as functionalism, conflict, neo-Marxism, and others. *Prep.: SOC 3100 and SOC 3101 (or equivalent) or consent of the instructor.*

SOC 3301 Recent Developments in Sociological Theory

New horizons in theory and the relation of theory to research. Topics to be selected and announced by the instructor. *Prep. SOC 3100 and SOC 3101 (or equivalent) or consent of the instructor.*

SOC 3302 Sociology of Knowledge

The relationship between the social base of a society and its intellectual products. The viewpoints of authors such as Marx, Weber, Mannheim, G.H. Mead, the Neo-Marxians, and other modern schools are considered. *Prep.: SOC 3100 and SOC 3101 (or equivalent), or consent of the instructor.*

SOC 3303 Economic Sociology

The role of economic factors in the social process. Consideration is given to both classic economic theory and its impact on classic social theory, and the potential interrelations between modern economic theory (especially model-building approaches) and general sociological problems.

SOC 3310, SOA 3311 Social and Cultural Change S,A

Two-quarter course in conjunction with Anthropology. Analysis of the changing patterns in social, economic, and political institutions. Modern social trends are discussed.

SOC 3320 Multiple Regression in Sociological Analysis

This course focuses on techniques of sociological analysis based on multiple regression, e.g., use of coded variables, trend analysis, covariance analysis, model testing. *Prep.: SOC 3117 and SOC 3115 (or equivalents).*

SOC 3321 Current Issues in Social Research

Selected topics in methods of social research are examined. *Prep.: SOC 3116 and SOC 3117 (or equivalent) or consent of the instructor.*

SOC 3322, SOC 3323 Experimental Methods in Social Research I, II

Experimental design and laboratory methods in sociology. The small groups laboratory is treated as a setting for testing sociological theory. The emphasis is upon techniques and problems in the creation and manipulation of social variables in the laboratory situation, although the techniques of the natural experiment are also considered.

SOC 3325 Sociology of Policy, Planning, and Evaluation

A general introduction to the social, political, and economic factors affecting policy formation and the eventual success or failure of social programs in health, education, welfare, and urban planning. Stress on evaluation of policy alternatives and planning problems. For advanced students in the social sciences and in the various human service schools of the University.

SOC 3335 Seminar in Symbolic Interaction

The social psychology of groups as found in the works of Mead, Becker, Blumer, Goffman, and others.

SOC 3336, SOC 3337, SOC 3338 Seminar on Socialization I, II, III

I) Instructor reviews theories and findings in organizational socialization. II) Students are expected to design studies in organizational socialization. III) Students are required to present results of their studies. *Not open to first year students.*

SOC 3345 Community Analysis

Ecological theories of human relations with the physical environment. Development of the concept of, and discussion of methods for, community study. Comparison between rural communities and urban neighborhoods. Discussion and evaluation of community action programs.

SOC 3347 Seminar in Urban Social Policies

Social science theories and methods evaluated from the perspectives of urban affairs. *Consent of instructor.*

SOC 3355 Political Sociology

Sociological analysis of power relations and power systems with special attention to the bases of political power, processes of change in power, and the part played by violence and revolutionary movements.

SOC 3357 Comparative Socialism

Analysis of twentieth century socialism from a comparative perspective. The variety of "socialisms" that have developed in the Soviet bloc, China, Yugoslavia, and Cuba, as well as Western social democracy (Sweden) and Eurocommunism. Topics include political structure, class relations, industrial organization, cultural formations, dynamics of change, and democratization.

SOC 3360 Social Stratification

Theories of inequality between groups in historical perspective, from classical to modern industrial times. Discussion and evaluation of sociological research in social stratification with regard to different social and cultural groups.

SOC 3365 Social Movements

A study of various movements for social change from all points of the political spectrum. Special attention will be given to the structural context, as well as to such processes of social movements as social base, leadership, strategy, and organization.

SOC 3390, SOC 3391 Seminar in Social Structure I, II

Seminar relating current theories and research in sociology, social psychology, and social anthropology.

SOC 3405 Theories of Criminology

Theories and philosophies underlying various correctional systems. Schools of thought in criminology and penology. Theoretical approaches to the crime and delinquency problem from the beginnings of criminology to current thinking.

SOC 3410, SOC 3411, SOC 3412, SOC 3413

Contemporary Issues in Sociology 3 Q.H. each
Contemporary issues in sociology. Supervised readings and written reports on special problems.

SOC 3430 Latin American Societies

Study and analysis of selected Latin American societies with particular attention to such countries as Cuba, Mexico, Peru, and Brazil. Emphasis on urbanization and industrialization, social and political change.

SOC 3431 Middle East Area Study

Sociocultural analysis of the Middle East. Ecological, structural, institutional, and normative factors in nomadic, rural, and urban life. Comparative regional analysis.

SOC 3470 Sociology of Religion

A sociological analysis of religious institutions and experiences in their historical and contemporary

rary content. Religion context and political context are considered.

SOC 3485 Computers and Society

Graduate seminar on the social impact of the computer "revolution" on the contemporary world. Topics include conditions of work, education, recreation, privacy, the computer science profession, paradigms of human thought, politics, and social change in the world economy.

SOC 3600, SOC 3601, SOC 3602 Seminar

3 Q.H. each

Discussion of selected topics in the field of sociology.

SOC 3603 Rhetoric in Sociology

Critical examination of the conventional forms of sociological writings. How conventions differ by theoretical perspective and paradigm.

SOC 3615 Tutorial in Teaching 3 credits max.

Discussion of issues and problems in teaching. This is a required course for all doctoral candidates and should be taken during a quarter when the student has major responsibility for designing and executing a course in either sociology or anthropology. Open to doctoral candidates only.

SOC 3620, SOC 3621, SOC 3622 Doctoral

Proseminar

1 Q.H. each

This course is required of all doctoral candidates and is designed to help socialize them for participation

as professional sociologists and anthropologists. Topics discussed include the nature of intellectualism and the functions of an intellectual in society today, the university as a structure and as a community of scholars, the nature of professional organizations, teaching sociology and anthropology, the organization of sociological and anthropological research, ethics in the profession, the nature of applied sociological and anthropological work. The course offers participants the opportunity to acquire practical experience in self-presentation and giving colloquia. *Prep.: SOC 3321 and SOC 3300 or SOC 3301 or SOC 3302 or consent of the instructor.*

SOC 3798 Master's Thesis Continuation 0 Q.H.

SOC 3799 Doctoral Dissertation Continuation 0 Q.H.

SOC 3800, SOC 3801, SOC 3802 Directed Study in Sociology Max.: 9 Q.H.

Reading and research under the direction of a faculty member. *Open to doctoral candidates only.*

SOC 3810 Master's Paper in Sociology 6 Q.H.

Empirical or library research meeting the criteria for publication in a professional journal. *Supervision by members of the department.*

SOC 3820 Doctoral Dissertation (No credit)

Biology

BIO 3509 Principles of Systematics 2 Q.H.

Presentation of theories and techniques employed in systematics; rules according to the International Codes of Zoological and Botanical Nomenclature.

BIO 3510 Environmental and Population

Biology

2 Q.H.

Physiochemical factors influencing and influenced by organisms. Interaction among individual organisms and among species. Students are expected to participate in lectures and laboratories given for BIO 1211. Individual work on specialized aspects of ecology is assigned. *Prep.: One year of general biology, including plant and animal biology. Open only to graduate students completing deficiencies in entrance requirements.*

BIO 3511 Aquatic Ecology 3 Q.H.

Chemical, physical, and biotic features influencing coastal, lake, and stream communities. Lectures. *Prep.: BIO 1211 or BIO 3510 or equivalent.*

BIO 3512 River Ecology Laboratory 3 Q.H.

Two four-hour sessions per week (combined lecture and lab). Chemical determinations, measurement of primary and secondary production, organismal identification in flowing waters of different types.

BIO 3517 Lake Ecology Laboratory 3 Q.H.

Two four-hour sessions per week (combined lecture and lab). Chemical determinations, measurement of primary and secondary production, organismal identification in lakes of different types.

BIO 3518 Ecology of Salt Marshes 3 Q.H.

Survey of fauna and flora, environmental factors affecting them, and current biological and social problems associated with salt marshes. This course will meet for two lectures of one and one-half hours each, and one full day of laboratory for six weeks during the summer quarter. *Prep.: BIO 1211 or BIO 3511 or equivalent.*

BIO 3519 Ecology of Rocky Shores 4 Q.H.

Examination of current ecological concepts regarding rocky intertidal and subtidal communities. The influence of biotic and abiotic factors on composition, distribution, and diversity of plant and animal species is emphasized.

BIO 3520 Environmental Microbiology 4 Q.H.

The microbial environment and ecology of the cell. Interactions between microbial populations, stressing soil and fresh-water associations. *Prep.: BIO 1320 or equivalent.*

BIO 3521 Food Microbiology 3 Q.H.

Microbiology of food with emphasis on pathogenic types and their interactions with other groups indigenous to food. Food fermentations, food processing, and environmental factors influencing growth and development of microorganisms in food. *Prep.: BIO 1320 or equivalent.*

BIO 3522 Food Microbiology Laboratory 2 Q.H.

Detection, quantification, and isolation of microorganisms and their products of significance in food with emphasis on the pathogenic types. *Prep.: BIO 3521 (may be taken concurrently).*

BIO 3527 Animal Virology 3 Q.H.

Physical and chemical properties of viruses, viral replication, genetics, cytopathology, and tumor viruses. Medical virology, including pathogenesis, clinical features, epidemiology, and immunization of the common viral diseases. *Prep.: BIO 1320 or equivalent.*

BIO 3528 Animal Virology Laboratory 2 Q.H.

Cultivation and identification of viruses. Use of animals, eggs, and animal cell cultures for viral assays. *Prep.: BIO 3527 (may be taken concurrently).*

BIO 3530 Plant Nutrition and Metabolism**4 Q.H.**

Mineral nutrition, photosynthesis, metabolic pathways, and translocation in higher plants.

BIO 3531 Plant Growth and Reproduction**4 Q.H.**

Plant hormones, growth, development, and physiology of reproduction. *Prep.: BIO 3530.*

BIO 3537 Marine Algae 4 Q.H.

Systematics, life histories, and ecology of marine algae, with emphasis on the flora of the Gulf of Maine (Marine Science and Maritime Studies Center).

BIO 3538 Plant Morphogenesis 4 Q.H.

The origin of form, experimentally controlled development, and external and internal factors that govern development of form. Plant tissue, organ, and cell culture techniques employed in the study of morphogenetic processes. *Prep.: BIO 1437.*

BIO 3547 Biomechanics I, Theory 4 Q.H.

An introduction to engineering theory and techniques as applied to the disciplines of morphology, evolution, and ecology. Topics include material properties, structural elements and systems, and elementary fluid dynamics. Laboratory emphasizes biological materials in a mechanical sense, the physical biology of flow, and an examination of the fundamental principles of physical laws that affect living organisms. *Prep.: Permission of instructor.*

BIO 3548 Biomechanics II, Applications 4 Q.H.

A forum for research in biomechanics in which students are expected to develop and execute a research project. In addition, current areas of

biomechanical research will be reviewed and evaluated. *Prep.: BIO 3547 and permission of instructor.*

BIO 3549 Physiology and Biomechanics of Animal Activity 3 Q.H.

An integrated study of the physiological and biomechanical systems that support locomotory activity in animals. The first part is devoted to the structure and function of skeletal muscle and to respiratory and cardiovascular adaptations for activity. The remainder integrates physiological and biomechanical information related to flying, swimming, and terrestrial locomotion. *Prep.: General physiology.*

BIO 3550 Cardiovascular Physiology 3 Q.H.

Physiology of blood cells, anemia, polycythemia immunity, and allergy. Electrophysiology of the heart, cardiac cycle, EKG, hemodynamics, capillary dynamics, pulmonary circulation, cardiovascular reflexes, cardiac output, and venous return. Cardiac failure, coronary circulation, atherosclerosis, hypertension, cerebral circulation, circulatory shock.

BIO 3551 Cardiovascular Physiology Laboratory**1 Q.H.**

Three hours of laboratory study per week. *Prep.: BIO 3550.*

BIO 3552 Osmotic and Ionic Regulation 2 Q.H.

Comparative physiology of regulation and transport of water and the principle solutes in animals. Principles and underlying mechanisms will be discussed, as well as examples selected from a variety of phyla. *Prep.: Basic physiology.*

BIO 3557 Environmental Physiology 3 Q.H.

Study of the mechanisms for short-term and chronic adaptation to changes in environmental conditions. Consideration of physiological responses to high altitudes, diving, thermal environment, space travel, and biological clocks. Endothermic vertebrates are emphasized. For students with background in physiology. *Prep.: Basic animal physiology or consent of instructor.*

BIO 3558 Vertebrate Endocrinology 3 Q.H.

Principles of hormonal regulation of physiological processes in vertebrates, mechanisms of hormone action, neuroendocrine relationships.

BIO 3559 Animal Nutrition 2 Q.H.

Detailed consideration of organic and inorganic nutritional requirements of humans and selected animals. Digestion, absorption, and metabolism of nutrient materials. Role of vitamins, minerals, and trace elements in metabolism. Variation in nutritional needs among normal individuals and in various physiological and genetic pathologies. Evaluation of food additives and of permissible levels of toxic materials in food. *Prep.: Basic biochemistry or consent of instructor.*

BIO 3560 Genetics and Developmental Biology**2 Q.H.**

Elaboration of the classic laws of heredity, including cytogenetics and chemical basis of heredity. Selected examples of the development of form and function. Students are expected to participate in lectures and laboratories given for BIO 1260 and are assigned extra individual work. *Prep.: General biology. Open only to graduate students completing deficiencies in entrance requirements.*

BIO 3561 Cell Physiology and Biochemistry**2 Q.H.**

Basic chemical and physical processes of cells related to their fine structure; oxidative and intermediary metabolism, photosynthesis, membrane phenomena; movement; chemical and physical processes of prokaryotic and eukaryotic cells. Students are expected to participate in lectures and laboratories given for BIO 1261. Extra, individual work is assigned. *Prep.: General biology, college physics, and organic chemistry. Only open to graduate students completing deficiencies in entrance requirements.*

BIO 3562 General Biochemistry**3 Q.H.**

A survey of the field of biochemistry with emphasis on protein structure, enzyme catalysis, bioenergetics, chemistry and metabolism of carbohydrates, lipids, amino acids, and nucleotides, and the synthesis and function of macromolecules in the contact of organelle development. *Prep.: Permission of instructor. Required of all entering graduate students in biochemistry, cell physiology, and molecular biology. Students may be exempted by successfully completing the final examination from a previous year's course.*

BIO 3567 General Biochemistry Laboratory**3 Q.H.**

An intensive course intended to introduce the student to modern research technique used in biochemistry and molecular biology. Topics include purification and characterization of proteins, kinetic properties of enzymes, isolation of high molecular weight DNA, recombination of DNA molecules *in vitro*, isolation of bacterial clones containing recombinant molecules, and *in vitro* mutagenesis. The course includes two hours of lecture and six hours of laboratory, all in one day. Lectures will include a discussion of safety and moral concerns raised by uses of genetic engineering. Required of all entering graduate students in biochemistry, cell physiology, and molecular biology.

BIO 3568 Microbial Biochemistry**4 Q.H.**

Study of enzymatic reactions, including their mechanism and regulation, involved in pathways of energy metabolism and biosynthesis by microorganisms. The mechanism of action and research use of antibiotics are discussed. *Prep.: A term or more of biochemistry.*

BIO 3569 Microbial Genetics**3 Q.H.**

Principles and practical application of the genetics of microorganisms. Genetic exchange in bacteria mediated by bacteriophage and plasmids is emphasized. Several eukaryotic systems are also discussed. *Prep.: BIO 1320 or equivalent.*

BIO 3570 Lower Invertebrates**4 Q.H.**

Taxonomy, morphology, embryology, and life histories of acoelomate phyla (Marine Science and Maritime Studies Center).

BIO 3571 Coelomate Invertebrates**4 Q.H.**

Biology of annelids, arthropods, molluscs, and echinoderma (Marine Science and Maritime Studies Center).

BIO 3572 Biology of Meiofauna**2 Q.H.**

Systematics and ecology of marine interstitial fauna. *Prep.: Invertebrate zoology.*

BIO 3577 Malacology**4 Q.H.**

Functional morphology, embryology, systematics, and ecology of the major groups of molluscs. *Prep.: Invertebrate zoology.*

BIO 3601 Biological Electron Microscopy**4 Q.H.**

Techniques of electron microscopy applied to biological materials. Specimen preparation, fixation, thin-sectioning, staining, operation of electron microscope, photographic techniques, interpretation of electron micrographs. Student seminars and project required. *Prep.: Consent of the instructor.*

BIO 3607 Advanced Developmental Biology**3 Q.H.**

Study of current concepts of animal and plant development at the molecular and physiological levels. Among topics of discussion are nucleic acid and protein synthesis in development, metabolic activation at fertilization, regulation of the eukaryotic genome, control of cell differentiation, and molecular communication between cells. Reading and interpretation of the primary literature is stressed. Three hours of lecture per week.

BIO 3608 Advanced Developmental Biology Laboratory**2 Q.H.**

Analysis of the fundamental problems of development through experimental techniques. Culture of vertebrate and invertebrate embryos, microsurgical analysis of morphogenesis, biochemistry of development, cell-cell interactions, and organ and tissue culture are studied. Five hours of laboratory per week. *Prep.: BIO 3607 or consent of the instructor.*

BIO 3609 Cellular Aspects of Development**3 Q.H.**

Study of animal and plant development at the cellular level. Among discussion topics are cell-cell interaction, cell surface differentiation, differential cell adhesion, genetic and epigenetic

control or pattern formation, and ultrastructural aspects of fertilization and development. Reading and interpretation of the primary literature are stressed. Three hours of lecture per week.

BIO 3610 Human Ecology 4 Q.H.

Human tolerances for natural and unnatural environmental factors and man's activities affecting these factors. Man, food, and population dynamics.

BIO 3617 Environmental Law 2 Q.H.

The scientific information required for implementation of the legal and political aspects of environmental management. The role of the scientist as an expert witness. Scientific and legal predictability. Analyses of suitable dynamic models and case law with the goal of improving the results of legal, political, and scientific decisions bearing upon remedial environmental management. *Prep.: Biology core and first course in physiology, e.g., BIO 1258 and BIO 1259.*

BIO 3620 Industrial Microbiology 3 Q.H.

Microorganisms and methods employed in production of products of economic and medical importance, decomposition of wastes, and control of desirable and unwanted processes and biodegradation. Fermentation processes emphasized. *Prep.: BIO 1420 or equivalent, or consent of instructor.*

BIO 3621 Industrial Microbiology Laboratory

2 Q.H.

Laboratory and discussion seminar sessions devoted to the study of selected commercial processes.

BIO 3650 Experimental Mammalian Physiology

4 Q.H.

Experimental study of the circulatory, respiratory, digestive, excretory, reproductive, nervous, and endocrine systems in mammals, with emphasis on laboratory procedures and surgical techniques used with living animals—primarily the rat. *Prep.: Background in physiology, consent of the instructor.*

BIO 3651 The Gastrointestinal Tract 3 Q.H.

Study of structure, function, and, where appropriate, the pathology of the gastrointestinal tract. Histological overview of the structure of all areas of the tract, including the liver and gallbladder, is followed by a functional analysis covering secretion, absorption, and bile formation and release. *Prep.: Basic animal physiology or consent of instructor.*

BIO 3652 Comparative Neurobiology 3 Q.H.

A cellular approach to structure and function of the nervous system. Topics to be covered include neuronal anatomy, cellular properties of single neurons, synaptic transmission, integration in nerve cells, nerve networks, sensory systems, motor systems, sensory-motor integration, specification of neuronal connectivity, and phylogeny

of nervous systems. *Prep.: General (animal) physiology.*

BIO 3657 Neurophysiology Laboratory 2 Q.H.

Introduction to neurophysiological methods. *Prep.: BIO 3652 (may be taken concurrently).*

BIO 3658 Nervous Control of Homeostatic Functions

3 Q.H.

Discussion of the nervous control of ventilation, heart and vascular system, water and salt intake, feeding and body weight, energy metabolism, arousal, pain mechanism, and factors affecting autonomic function. Emphasis on higher vertebrates. *Prep.: Basic animal physiology.*

BIO 3659 Renal Physiology

2 Q.H.

An in-depth study of the mammalian kidney. Examination encompasses structure and its relationship to function. Functional aspects are related to the mechanisms of ionic balance, water balance, and acid-base balance necessary for the maintenance of the total organism. Effects of hormones on the kidney and kidney hormones on the total organism are also covered. *Prep.: Physiology, cell biology, or permission of instructor.*

BIO 3660 Cell Biophysics and Biochemistry

5 Q.H.

Biogenesis and ultrastructure of the cell considered along with biophysical procedures and biochemical patterns used in the study of cellular and tissue components. Lecture only. *Prep.: Organic chemistry, general biology, biochemistry, and cell biology.*

BIO 3661 Human Genetics

3 Q.H.

Application of basic genetic principles to the study of variability in humans. Course focuses primarily on cytogenetics, biochemical genetics, monogenic, and multifactorial inheritance and population genetics. Topics of special interest include sex determination and differentiation, early embryology, twinning, birth-defect etiology, prenatal diagnosis, and genetic counseling. *Prep.: BIO 1260 or equivalent.*

BIO 3667 Biochemistry Laboratory Rotation I

3 Q.H.

Experience is gained in biochemical research by spending six weeks in each of two laboratories during the winter quarter. Required of all first-year graduate students in biochemistry, cell physiology, and molecular biology.

BIO 3668 Biochemistry Laboratory Rotation II

3 Q.H.

A continuation of BIO 3667 during the spring quarter.

BIO 3669 Biochemistry Laboratory Rotation III

3 Q.H.

A continuation of BIO 3668 during the summer quarter intended for students who have not yet chosen a laboratory in which to carry out thesis work. Not recommended except where necessary.

BIO 3670 Developmental Biology of Marine Invertebrates**5 Q.H.**

Descriptive and experimental studies of embryonic and larval development of marine invertebrates. Laboratory work includes observation and experimentation using live material from a broad spectrum of invertebrate phyla (Marine Science and Maritime Studies Center).

BIO 3671 General Helminthology**3 Q.H.**

Morphology, life histories, and biology of helminths parasitic in animals.

BIO 3672 Ichthyology**4 Q.H.**

Natural history and systematics of fishes, with emphasis on marine species (Marine Science and Maritime Studies Center). *Prep.: Comparative anatomy or vertebrate zoology.*

BIO 3690 Seminar**1 Q.H.**

Various topics and recent developments in botany, biochemistry, microbiology, molecular biology, physiology, and zoology are covered in depth. Student presentations are emphasized. To facilitate the planning of assignments, students are urged to contact the instructor during the quarter before the seminar is to be offered.

BIO 3691 Special Topics in Biology**(credit variable)**

Special study of a selected topic under direction of a faculty member, preliminary to submission and approval of M.S. thesis proposal or M.S. literature dissertation proposal. Topic and direction of study to be arranged with the faculty member supervising the study. *Credits convertible to M.S. thesis or M.S. dissertation.*

BIO 3692 Special Investigations in Biology**(credit variable)**

Studies of a topic not directly related to research being pursued for a thesis or dissertation. May take the form of a special course.

BIO 3697 M.S. Thesis**(credit variable)**

Research methods of some special field and their application to a specific problem, under direction of a graduate faculty member.

BIO 3698 M.S. Literature Dissertation**(credit variable)**

An extensive literature research under the direction of a graduate faculty member leading to a

comprehensive written review of a significant biological problem and an oral examination.

BIO 3699 Ph.D. Dissertation

Original research in depth, representing a significant contribution of new biological knowledge, and a written dissertation thereon, under the supervision of a graduate faculty member.

BIO 3798 Master's Thesis Continuation**0 Q.H.****BIO 3799 Doctoral Dissertation Continuation****0 Q.H.****INT 3101 Biochemistry I****2 Q.H.**

Description of the components of biochemistry, including the chemistry of carbohydrates, lipids, prostaglandins, steroid hormones, amino acids, polypeptides, proteins, purines, pyrimidines, nucleosides, and nucleic acids. Consideration of Henderson-Hasselbalch expression, buffers, and importance of pKa. *Prep.: two quarters of organic chemistry.*

INT 3102 Biochemistry II**2 Q.H.**

Discussion of enzymes, enzyme kinetics, and mechanisms of enzyme reactions. An introduction to the methods used to study intermediary metabolism, bioenergetics, biological oxidation reduction reactions, and the electron transport chain. A consideration is made of carbohydrate metabolism, including the citric acid cycle, the Embden-Meyerhoff pathway, and the pentose phosphate pathway. Use of isotopes in biochemistry and the role of high-energy phosphate compounds are outlined. *Prep.: INT 3101.*

INT 3103 Biochemistry III**2 Q.H.**

Lipid metabolism is presented, including the fatty acid cycle, biosynthesis of fatty acids, and biological formation of prostaglandins, cholesterol, and steroid hormones. The metabolism of various amino acids is considered, including the urea cycle, one-carbon fragments, transamination reactions and aromatic hydroxylations. Metabolism of nucleic acids and their building blocks are discussed, as well as the genetic basis of protein synthesis, genetic code, and mechanisms of control. *Prep.: INT 3102.*

Chemistry

All courses carry two quarter-hours of credit unless otherwise specified.

CHM 3401, CHM 3402, CHM 3403 Special Topics in Chemistry: Chemistry and Society I, II, III

Special topics of current importance, including chemical aspects of the environment; pollution and its determination, pesticides, carcinogenics,

resources; chemical aspects of energy conversion and storage: fossil fuels and fuel analysis; nuclear reactors; storage batteries; hydrogen production and storage; solar energy, photovoltaic cells and photochemistry; energy-related materials. *Prep.: Bachelor's degree in science or engineering.*

CHM 3420 Modern Methods of Analysis 2 Q.H.
Similar to CHM 3430, but without laboratory.
Prep.: Consent of instructor.

CHM 3430 Modern Methods of Analysis 3 Q.H.
Training in a wide variety of modern methods of instrumental analysis with extensive "hands-on" experience offered by a laboratory section. Areas covered include data handling; spectroscopy (UV-visible and IR absorption, luminescence, X-ray, atomic absorption and mass spectrometry), separations (gas and modern liquid chromatography, TLC); pulse polarography; X-ray diffraction; microscopy (optical and scanning electron microscopy, including X-ray fluorescence microanalysis), computerized instrumentation. (Restricted to students in the Forensic Chemistry M.S. program, except by special arrangement.)

CHM 3501 Polymer Chemistry I
Introduction to polymers. Major emphasis on synthesis. Step-reaction, chain-reaction, and ring-opening polymerizations. Copolymerization. Three-dimensional polymers and crosslinking.
Prep.: One year of organic chemistry and one year of physical chemistry.

CHM 3502 Polymer Chemistry II
Physical chemistry of polymers in solution and bulk. Molecular characterization. Mechanical and physical properties in the glassy, rubbery, viscous, and semicrystalline states. *Prep.: CHM 3501.*

CHM 3503 Polymer Chemistry III
Industrial practice, polymer processing, fibers, elastomers, coatings, adhesives, and reinforced plastics. Relationship of polymer structure to usage. *Prep.: CHM 3502.*

CHM 3510 Special Projects in Chemistry
Laboratory studies on a topic not directly related to research pursued for a thesis. *Prep.: Permission of the departmental faculty is required.*

CHM 3521 Analytical Separations
Theory and practice of analytical separation techniques. Emphasis is on fundamentals as they relate to practice. Topics for examination are based mainly on chromatographic processes including gas and high speed liquid chromatography. Other topics include zone refining, liquid-liquid extraction, and electrophoresis

CHM 3522 Advanced Analytical Separations
Continuation of CHM 3521. *Prep.: CHM 3521.*

CHM 3523 Electroanalytical Chemistry I
The theory, applications, and instrumentation for potentiometry, pH, ion selective electrodes, conductancy, and high-frequency measurements. The techniques of direct measurement, titration end-point detection, and on-line measurements.

CHM 3524 Electroanalytical Chemistry II
The theory, applications, and instrumentation for electrogravimetry, polarography, voltammetry,

chronopotentiometry, and coulometric titration. Techniques for direct measurement, titration end-point detection, and on-line measurements. *Prep.: CHM 3523.*

CHM 3525 Optical Methods of Analysis I
Theory and practice of absorption spectrometric methods of analysis. Optics and basic instrumental considerations.

CHM 3526 Optical Methods of Analysis II
Emission and fluorescence methods of analysis, including atomic techniques, X-ray fluorescence, and Raman spectrometry. *Prep.: CHM 3525.*

CHM 3528 Computers In Chemistry 3 Q.H.
A laboratory-lecture course illustrating the use of small digital computers for real-time control of chemical instruments. Topics include digital logic, real-time data structures, A/D and D/A conversion, noise and other aspects of real-time computer interfacing. Programming is done on a PDP-11 computer in MIRACL, a language designed for real-time processing. *Prep.: Consent of instructor.*

CHM 3531, CHM 3532, CHM 3527 Special Topics in Analytical Chemistry I, II, III
Selected topics of current importance in analytical chemistry. *Prep.: Consent of instructor.*

CHM 3541 Advanced Inorganic Chemistry I
Application of basic quantum chemistry to inorganic systems. Russell-Saunders and j-j coupling. Stereochemistry of nontransition-metal compounds, bonding and structure of electron-deficient systems.

CHM 3542 Advanced Inorganic Chemistry II
Magnetic properties; electronic spectra and selection rules. Thermodynamic stability of coordination compounds. Experimental techniques of inorganic chemistry. *Prep.: CHM 3541.*

CHM 3543 Advanced Inorganic Chemistry III
Crystal symmetry. Introduction to theory of lokids; semi-conductors and metals; non-stoichiometric compounds; solid-state reactions. Application of molecular orbital theory. Determination of electron distribution in transition metal compounds. Mossbauer spectroscopy and advanced magnetochemistry. *Prep.: CHM 3542 and CHM 3591.*

CHM 3561, CHM 3562 Advanced Organic Chemistry I, II
An intensive survey of organic reactions. Modern concepts of structure and mechanism are used to correlate factual material. *Prep.: One year of organic chemistry.*

CHM 3563 Physical Organic Chemistry
Topics in basic physical organic chemistry: molecular polarity, equilibrium and kinetics, reactivity and structure, solvent effects, acid-base catalysis, orbital symmetry, aromaticity. *Prep.: CHM 3562 or consent of instructor.*

CHM 3564 Spectrometric Identification of Organic Compounds

Interpretation of the ultraviolet, infrared, and nuclear magnetic resonance spectra of organic compounds. *Prep.: One year of organic chemistry.*

CHM 3581 Chemical Thermodynamics I

First Law of Thermodynamics, Thermochemistry Second and Third Laws, free energies, reaction end phase equilibria. *Prep.: Consent of instructor.*

CHM 3582 Chemical Thermodynamics II

Partial molar properties, solutions, electrolytes. Statistical analogues of entropy and free energy, partition functions. *Prep.: CHM 3581.*

CHM 3583 Chemical Thermodynamics III

Statistical thermodynamics applied to gases, liquids, and solids. Irreversible thermodynamics. *Prep.: CHM 3582 and CHM 3592.*

CHM 3591 Introductory Quantum Chemistry I

Introduction to quantum mechanics. Application to simple systems. Perturbation theory and applications. Harmonic oscillator, rigid rotor and applications to microwave and infrared spectroscopy. Simple atoms. *Prep.: One year of physical chemistry.*

CHM 3592 Introductory Quantum Chemistry II

The variational method. The chemical bond $H + 2$. The LCAO method. Group theory and applications. Molecules. Woodward-Hoffman rules. *Prep.: CHM 3591.*

CHM 3593 Introductory Quantum Chemistry III

Application of group theory and simple approximate theories to conjugated molecules. The SCF method and its application to atoms and molecules. Applications to molecular spectroscopy. *Prep.: CHM 3592.*

CHM 3594 Chemical Kinetics

Use of experimental data to deduce the rate law of a reaction. Mechanisms deduced from rate laws. Influence of experimental error on precision of rate constants and activation energies. Collision- and transition-state theories of reaction rates. *Prep.: One year of physical chemistry.*

CHM 3641 Coordination Chemistry

Solution phase properties of coordination compounds. Experimental methods for the study of thermodynamics stability and kinetic lability. Kinetics and mechanism of solvent exchange and substitution reactions at transition metal centers. Classification of redox reaction mechanisms. Marcus theory. Phenomenological mechanisms. *Prep.: CHM 3543.*

**CHM 3642, CHM 3643, CHM 3644, CHM 3645
Special Topics in Inorganic Chemistry I, II, III, IV**

Advanced topics of importance in inorganic chemistry including advanced ligand field theory; crys-

tal field theory of ions in weak and strong fields. Molecular orbital theory of transition metal complexes. Crystal structure determination in solids: crystallography, X-ray, electron and neutron diffraction techniques applied to inorganic, bio-inorganic and other solids. Resonance spectroscopy in inorganic chemistry, including electron spin, nuclear magnetic, and nuclear quadrupole resonance; and Mossbauer spectroscopy. Solid-state chemistry: thermal, magnetic and transport properties; phase transformations and crystal defects; surface effects, material preparation techniques. *Prep.: CHM 3542 and consent of instructor.*

CHM 3661, CHM 3662 Organic Stereochemistry and Reaction Mechanisms I, II

Interrelations of the stereochemistry of organic molecules with their physical and chemical behavior. Conformational analysis. The effects of spatial relationships on transition states, equilibria, and reaction rates as an introduction to the study of organic reaction mechanisms. *Prep.: CHM 3563.*

CHM 3663, CHM 3664 Organic Reaction Mechanisms and Organic Synthesis I, II

The fundamental factors influencing the courses of organic reactions. Substitution reactions. Pericyclic reactions. Synthetic methods as an introduction to organic synthesis. *Prep.: CHM 3662 or concurrent registration therein.*

CHM 3671, CHM 3672, CHM 3673 Special Topics in Organic Chemistry I, II, III

Selected topics of current importance in organic chemistry. *Prep.: CHM 3562 and consent of instructor.*

CHM 3681, CHM 3682, CHM 3683 Special Topics in Physical Chemistry I, II, III

Advanced topics of importance in physical chemistry including quantum chemistry: linear algebra and the formulation of quantum theory. Angular momentum. Group theory. Small molecules. Time-dependent theory and selected advanced topics. Statistical mechanics. Quantum statistics; electrons in metals, photons, and phonons; superconductivity; fluctuations, noise, and irreversible thermodynamics; transport phenomena; phase transitions of high order. *Prep.: Consent of instructor.*

CHM 3800, 3801, 3802, 3803 Seminar 1 Q.H.
Oral reports by the participants on current investigations in chemistry. *Prep.: Enrollment in full-time program.*

CHM 3810 Research for M.S.

(Maximum: 14 Q.H.)

Original research and a written thesis thereon, under supervision of a faculty member.

CHM 3820 Research and Dissertation for Ph.D.

Original research in depth, representing a significant contribution of new chemical knowledge, and a written dissertation thereon, under the supervision of a faculty member. *Prep.: Doctoral candidacy.*

INT 3101 Biochemistry I

Discussion of the structures and chemistries of carbohydrates, proteins, lipids, nucleic acids, and selected cofactors. *Prep.: One year organic chemistry.*

INT 3102 Biochemistry II**2 Q.H.**

Discussion of enzymes, enzyme kinetics, and mechanisms of enzyme reactions, of intermediary metabolism and of bioenergetics, biological oxidation-reduction reactions and the electron transport chain. A consideration is made of carbohydrate metabolism including the glycolytic pathway, the citric acid cycle and the pentose phosphate pathway. *Prep.: INT 3101. Offered summer and winter quarters.*

INT 3103 Biochemistry III

Continuation or intermediary metabolism from Biochemistry II, including lipid, protein, and nucleic acid metabolism, photosynthesis, and cell regulation. *Prep.: Biochemistry II, INT 3102.*

Economics

All courses carry three quarter-hours of credit unless otherwise specified. Courses indicating macroeconomics theory as a prerequisite refer to ECN 3120 (for M.S. degree students) and ECN 3220 (for M.A. degree students).

ECN 3010 Introduction to Intermediate Microeconomic Theory

Intensive coverage of basic micro theory. This course is designed for M.A. degree students who need to improve their background in micro theory and carries no academic credit toward the M.A. or Ph.D. programs.

ECN 3020 Introduction to Intermediate Macroeconomic Theory

Intensive coverage of basic macro theory. This course is designed for M.A. degree students who need to improve their background in macro theory and carries no academic credit toward the M.A. or Ph.D. programs.

ECN 3030 Introduction to Mathematics for Economists**0 Q.H.**

This course helps acquaint students with matrix algebra and elementary calculus necessary for quantitative economics: simultaneous linear systems; polynomial, logarithmic, and exponential functions; and elementary differential and integral calculus. *This course offers no credit toward a degree in economics.*

ECN 3040 Introduction to Statistics**0 Q.H.**

An introduction to statistical methods and techniques used in economic analysis. Descriptive statistics, time-series and index number problems, sampling problems, introduction to probability theory, and hypothesis testing. This course is designed for M.A. degree students who need to improve their background in basic statistics and carries no academic credit toward the M.A. or Ph.D. programs.

ECN 3110 Introduction to Intermediate Microeconomic Theory

Intensive coverage of basic micro theory. This course is designed for M.A. degree students who need to improve their background in micro theory and carries no academic credit toward the M.A. or Ph.D. programs.

ECN 3120 Introduction to Intermediate Macroeconomic Theory

National income definitions and measurements, Keynesian models, multipliers, growth models, investment, consumption and monetary theories. *(4 cr. for MSEPP)*

ECN 3130 Introduction to Mathematics for Economists

Seeks to acquaint the student with the algebra and elementary calculus necessary for quantitative economics: simultaneous linear systems; polynomial, logarithmic, and exponential functions; and elementary differential and integral calculus. *(3 cr. for MSEPP)*

ECN 3140 Introduction to Statistics

An introduction to statistical methods and techniques used in economic analysis. Descriptive statistics, time-series and index number problems, sampling problems, introduction to probability theory, and hypothesis testing. *(4 cr. for MSEPP)*

ECN 3150 Microeconomic Policy Planning Seminar**4 Q.H.**

Cost efficiency and effectiveness, assessment of externalities, shadow prices, benefit-cost analysis, project implementation and evaluation, budget

analysis, evaluation of public programs, role of private and public sectors, relationship of projects and macro planning, use of analysis by policymakers. *Prep.: ECN 3110, ECN 3140 co-requisite.*

ECN 3151 Macroeconomic Policy Planning Seminar 4 Q.H.

Role of public sector in the economy. Socio-economic objectives and public policies. National economic planning and synthesis of models for growth and development. Tools and techniques for economic planning. Construction and utilization of input-output tables. Planning and policy implementation and evaluation. *Prep.: ECN 3120, ECN 3140 co-requisite.*

ECN 3152 Workshop in Economic Planning and Policy

Empirical work involving micro and macro planning techniques, applying the latter to individual case studies of a specific plan, program, or organization. Students are expected to prepare and present a research paper on a chosen case study, demonstrating the ability to use planning techniques. *Prep.: ECN 3150 and ECN 3151.*

ECN 3210 Microeconomic Theory I 4 Q.H.

A non-math treatment of microeconomic theory at the beginning graduate level. An investigation of the conditions underlying consumer and producer equilibrium under different objective functions and various market structures. Derivation of product demand curves, supply curves, and factor demand curves for alternative market structures in product and factor markets are surveyed.

ECN 3220 Macroeconomic Theory I 4 Q.H.

Income and employment theory; classical Keynesian, and post-Keynesian aggregate demand and supply systems.

ECN 3240 Statistical Inference 4 Q.H.

A study of statistical methods and techniques. Probability theory and models, testing economic hypotheses, analysis of variance, ordinary least-squares regression, t-statistics and f-statistics. Correlation analysis. *Prep.: ECN 3040 or statistics examination.*

ECN 3241 Econometrics I 4 Q.H.

Estimation of demand, supply, cost, and production functions; applications of multivariate analysis of economic data; identification; determination of trend, oscillation, and periodic movements; autocorrelation and correlogram analysis, trends in multiple regressions.

ECN 3310 Case Studies In Applied Microeconomics

Topics in applied microeconomics. Case studies on organizational decision making for such problems as short-run and long-run forecasting of demand, price policy, financing of investments, location of plants, and response to government regulations and taxation. *Prep.: ECN 3010 or ECN 3110.*

ECN 3330 Economic Programming

Economic programming with emphasis on linear programming, simulation and queuing theory with applications to the computer. *Prep.: ECN 3530.*

ECN 3331 Accounting for Economists

An overview of private and public sector accounting systems and techniques to assist students in developing the ability to use these techniques in obtaining data and analyzing problems. Topics covered include national income accounts, balance-of-payment accounts, the private firm's balance sheet, income statement and flow-of-funds statement. Other issues, such as real vs. nominal magnitudes and depreciation techniques, are also covered.

ECN 3350 Economics of the Labor Market and Labor Force I

Labor force measurement and determinants, women's changing role in the labor market; micro-analysis of labor supply and demand, varieties of labor markets and their functioning, minimum wages; wage structures and differentials, labor allocation and migration; union impact on wage levels and structures; macro-wage-employment determination, macro-wage-price problems, income policies. Applications to developing and developed economies.

ECN 3351 Economics of the Labor Market and Labor Force II

Unemployment and underemployment, technological change and changing skill requirements; income distribution and poverty; human capital theories and human resource development; employment and training policies to raise personal earnings, income maintenance programs. Topics discussed in relation to developing and developed economies.

ECN 3352 Economics of Manpower Planning I

The role of manpower planning and its integration with general development planning. Analysis and evaluation of different techniques of manpower planning. Technological versus economic methods. Practice of manpower forecasting and data problems. Skill training versus educational strategies. Models of educational planning and their applications to different countries. *Prep.: Microeconomic theory.*

ECN 3353 Economics of Manpower Planning II

Applications of manpower planning methods and techniques to problems of national economic development. Cost-benefit and cost-effectiveness of educational and manpower programs. Special problems of health manpower, scientists, engineers, and technicians. Evaluation of methods and prediction used in national manpower plans. *Prep.: ECN 3352.*

ECN 3354 Economics of Medical Care and Health Manpower

The organization of medical care, the problems associated with various alternative delivery systems. The utilization and availability of physicians and other paramedical personnel, the growth and pressures exerted by third-party payers; and consideration of federal, state, and municipal participation in the delivery of quality medical care under various alternatives for national health insurance.

ECN 3355 Economics of Education

An examination of the contribution of education to the process of economic growth and the way education is produced and distributed. Special topics include inequalities in returns to education; the role of intelligence and class background in educational success; and socializing role of education in production.

ECN 3356 Local Labor Markets: Research Methods and Problems

Analytical framework and empirical measures for determining the nature and operation of state and local labor markets. Varieties of local labor markets; use of data from public agencies to examine such markets; composition of local labor force, sources of local labor supply, industrial and occupational mix, local wage and salary structures, local income distribution.

ECN 3357 Human Resources Planning at State and Local Areas

Applied workshop in methods and techniques for planning human resource programs at state and local levels. Economic tools for state employment services, prime sponsors, and other service deliverers for designing, implementing, monitoring, and evaluating employment and training programs. Use of statistical packages in human resources planning.

ECN 3358 Economics of Education and Training Programs

Economic analysis of the relative effectiveness of different education and training programs at the state and local level. Implications of human capital theory; methods for coordinating alternative programs and determining their effectiveness. Rates of return, cost-effectiveness, cost-benefit. Applications to policy and program planning.

ECN 3359 Seminar in Human Resource Development

Selected topics on the development and use of human resources. *Prep.: Consent of instructor.*

ECN 3360 Regional Economics

Delineating regions. Theories of location for firms, industries, and people. Regional income accounting systems and models of intra- and interregional income determinants and impact analysis. *Prep.: Microeconomic theory.*

ECN 3361 Externalities

Theoretical foundations for urban and regional economics. Survey of economic theory related to externalities and welfare economics. *Prep.: ECN 3210 and consent of instructor.*

ECN 3362 Economics of Crime

A discussion of the resource allocation problem as it relates to criminal behavior and effective law enforcement. Evaluation of costs and benefits of alternative law enforcement policies. Criminal activity, including organized crime, is analyzed in an economic context.

ECN 3363 Urban Economic Systems

The economy of cities. Analysis of intrametropolitan spatial relationships including residential location, land, and housing markets. *Prep.: Microeconomic theory.*

ECN 3364 Urban Economic Development

Continuation of Urban Economic Systems. Problems in urban economics including segregation, housing, transportation, urban renewal, and related policy issues. *Prep.: ECN 3363.*

ECN 3365 Economics of Urban Transportation

Urban agglomeration, economic activities, residential concentration, and transportation network; urban and suburban densities in relation to the central place, capital budgeting; pricing; costs incidence and externalities of various modes; cost-benefit analysis; effects of transportation patterns on urban socioeconomic life; modal split and forecasting economic requirements for integrated urban transport needs.

ECN 3366 Economics of Intercity Transportation

Investigates the rationale for intercity freight and passenger movements within the framework of interregional commodity flows. The choice of mode once traffic volume has been determined. Study also covers the economic and environmental impacts of the choice of mode.

ECN 3369 Urban/Regional Economics Seminar

Selected topics in urban/regional economics. *Prep.: Consent of instructor.*

ECN 3370 Economic Development

A study of the prospects of economic growth in less developed areas. Measurement and theories of economic development. Role of human and natural resources, education, technology, and capital formation in national, regional, and sectoral development. Changes in institutions.

ECN 3371 Regional Development

Methodology and application of techniques for planning in multiregional systems. Empirical examples.

ECN 3372 Comparative Economic Development

Case studies of less developed countries at differing stages of economic development.

ECN 3373 Development Finance and Trade

Sources of investment finance in developing countries; role of taxation and tax structure reform; development of financial institutions and capital markets; private and official finance from abroad and debt-service problems; problems of monetary management and export instability.

ECN 3379 Development Planning Seminar

Political and economic plans. Survey of neoclassical growth models. Input-output techniques in open and closed models. Elements of linear programming; optimal decision techniques. Processes of implementation of planning; interaction of public and private sectors. Guide to empirical applications. *Prep.: ECN 3120 or ECN 3220 and ECN 3370 or consent of instructor.*

ECN 3380 Monetary Theory

A study of the relationships between money and economic activity with emphasis upon various quantity theory models and theories of the demand for money and velocity. *Prep.: Macroeconomic theory.*

ECN 3381 Monetary Policy

A study of the interrelationships between aggregate economic activity, financial markets, and central banking instruments, objectives, and policy.

ECN 3382 Public Policy and Finance

Techniques of fiscal policy, fiscal policy norms, public sector debt; tax policy; federal tax reform; the conflict between social implications of price stabilization and full employment; public expenditure policy and the interrelationship between monetary and fiscal controls. *Prep.: Macroeconomic theory.*

ECN 3383 Intergovernmental Fiscal Relations

A study of the development of the federal system, interstate and interarea fiscal comparisons, grants-in-aid, tax credits, revenue sharing, state and local taxes, nontax revenues, borrowing and budgeting at the state and local level, and a discussion of the process and prospects of state and municipal equalization of tax burden and efforts. *Prep.: Microeconomic theory.*

ECN 3384 Capital Markets

Primary sources of savings and demand for financial assets; role of financial intermediaries; banking system and government lending agencies. Demand for funds and real investment—mortgage, corporate, and government securities markets; interdependence of rate structures. Flow-of-funds data in relation to national income accounts.

ECN 3389 Money, Credit, and Banking Seminar

Selected topics in the economics of money, credit and banking. *Prep.: Consent of instructor.*

ECN 3510 Microeconomic Theory II 4 Q.H.

Theory and problems of macro-dynamics, growth, inflation cycles, and stabilization policy. *Prep.: ECN 3220 and consent of instructor.*

ECN 3511 Economics and the Law 1 Q.H.

Topics in the application of microeconomic principles to the law, such as property rights, torts, contract law, and the regulation of business. *Limited to Law, Policy, and Society students.*

ECN 3520 Macroeconomic Theory II 4 Q.H.

Theory and problems of macro-dynamics, growth, inflation, cycles, and stabilization policy. *Prep.: ECN 3220 and consent of instructor.*

ECN 3530 Mathematics for Economics 4 Q.H.

Application of matrix algebra and simple multivariate calculus to economic analysis. Static organization and dynamic analysis; difference and differential equations. Examples from economic theory. *Prep.: ECN 3030 or mathematics examination.*

ECN 3540 Econometrics II 4 Q.H.

Asymptotic and small sample properties of various estimators; rank-order conditions for identification; specification error and error in variables; remedies for autocorrelation and multicollinearity; dummy variables; distributed lags; forecasting and simulation; non-linear estimation; alternative estimation technique (two-stage least squares, three-stage least squares, maximum likelihood estimators, etc.) *Prep.: ECN 3241.*

ECN 3601 Doctoral Research Seminar I 4 Q.H.

Prep.: 12 q.h. of field work and consent of instructor.

ECN 3602 Doctoral Research Seminar II

4 Q.H.

Prep.: ECN 3601.

ECN 3798 Master's Thesis Continuation 0 Q.H.**ECN 3799 Doctoral Dissertation Continuation**

0 Q.H.

ECN 3890 Master's Thesis Seminar

(maximum 6 Q.H.)

Thesis supervision by members of the department; approval of graduate adviser required.

ECN 3895 Readings in Economics

(up to 3 Q.H.)

Supervised reading in selected topics in economics. *Prep.: Consent of instructor and approval of graduate adviser.*

ECN 3899 Doctoral Dissertation Seminar

(no credit)

Prep.: Approval of graduate adviser required.

English

All courses carry three quarter-hours of credit unless otherwise specified.

ENG 3300 Introduction to Literary Study

Materials and techniques of research. Writing a research paper. Approaches to literary study with consideration of both traditional and contemporary views.

ENG 3311 English Prose Style

The development of prose style in English (chiefly expository), from the sixteenth century to the present. Most major authors are represented, from Roger Ascham to James Baldwin.

ENG 3312 Theory and Teaching of Writing

Designed for teachers or prospective teachers of writing in college or the public schools, this course examines several premises of writing instruction and how they can provide successful classroom practices.

ENG 3315 Theories of Criticism

An introduction to the study of modern and contemporary literary theory and criticism: "New Critical," Marxist, psychoanalytic, structuralist, poststructuralist, phenomenological, and others.

ENG 3316 Critical Schools

A seminar concentrating on one or several related recent developments in literary theory and criticism such as structuralism or poststructural criticism. The subject of the seminar changes from year to year.

ENG 3321 Linguistics and Literary Study

Language viewed in its special function as literary medium. Linguistic approach to style, metaphor, form, and meaning. Representative works of major writers, poetry and prose, studied for characteristic formal properties. Discussion of contribution of linguistic analysis to literary criticism and to a theory of literature.

ENG 3322 Linguistics and the Art of Writing

Aspects of linguistics related to written forms of communication. Both fictional and nonfictional prose are represented. Topics in discourse analysis, textual cohesion, point of view and its effect on syntactic options, syntactic symbolism where syntax replicates meaning. Such problems as language and deception, speech and judgment, rhetoric and persuasion are also considered.

ENG 3323 Theatrical Styles

An examination of modern dramatic expression and theory with particular attention to absurdist drama, existentialist drama, and Brecht's theatre of alienation.

ENG 3324 Perspectives on American Literature

An attempt to discover common themes and recurrent patterns in American literature through a close reading of critics as various in their approach as Lawrence, Parrington, Chase, Pearce, and Fiedler.

ENG 3348 Research Materials and Methods for Technical Writing

This course will examine research sources in science, technology, and various professions. Such sources include computer searches, on-line data, corporate holdings, and specialized publications in engineering, computer science, the sciences, medicine, and business. Examples are the *IEEE Transactions*, the *New England Journal of Medicine*, U.S. Government publications, and the like. (An annotated list of technical reference guides appears in Houpp and Pearsall's *Reporting Technical Information*.)

The course will also explore interviewing experts and using nonprint media as resources in science, technology, and business.

In addition to sources of scientific and technical information, publications in the areas of technical and business communication will be considered. These include the *ITCC Proceedings*, *Technical Communication*, and others, including bibliographies in the area.

In addition, the course will examine style guides particular to branches of technical and scientific writing. These include U.S. Government *Style Manual* (1983), military documentation specifications, the *Chicago Manual of Style*, and various corporate style guides (Digital Equipment Corporation, IBM, General Electric, and others).

ENG 3349 Workshop in Writing for Publication

This course will examine published articles in scientific, technical, and professional journals and magazines. The articles will be evaluated for content, style, tone, format, and mechanical details. Students will evaluate the article's success, its professionalism, its appropriateness and timeliness, and the professional standards of the journal.

Concurrently, students will research, write, and revise an article for submission to a professional journal of their choice. Members of the class will review and edit these articles before submission. The goal of the course is to have an article accepted for publication.

Technical editing approaches will be included in the course as they are appropriate.

Throughout the quarter, area authors whose articles appear in scientific and technical journals will be asked to present guest lectures, discussing both their field of expertise and their writing efforts. We may be able to call on Alan Leitman, whose column appears in *Science 83*, Tracy Kidder, author of *Soul of a New Machine* and contributor to *OMNI*, and various contributors to area publications such as *Computerworld* and the *New England Journal of Medicine*.

ENG 3350 Creative Writing I

Prose fiction.

ENG 3351 Creative Writing II

Poetry.

ENG 3352 Writing for the Professions

This course examines the various forms of business communications and offers practical experience in writing business letters, memoranda, case studies, proposals, and reports. For students in the Graduate School of Business Administration.

ENG 3353 Problems in Writing

This course examines writing problems in general as well as those which are specific to professional interests.

ENG 3354 Technical Writing

Technical writing assignments, including correspondence, description, instructions, proposals, and reports. Use of graphics, layout techniques, and visual aids. Emphasizes audience definition, editing, and rewriting.

ENG 3355 Topics in Technical Writing

Writing assignments related to computers and the computer industry. Preparation of operator's manual and program documentation (instructions for running a program in a programming language such as BASIC or PASCAL). Course offers experience in editing and revision and work with graphics and layout in preparing assignments.

ENG 3358 Topics in Nonfiction Prose

This course will examine writings in nonfiction prose in such areas as biography, history, science, and technology. The content of the course will vary according to the design of the instructor.

If the course is given as an elective primarily for students in the Master of Technical and Professional Writing program, it should include science writing and writing about technology. Such a course could, for example, be primarily historical, focusing on writers in the nineteenth century and before, including Leonardo DaVinci, Galileo, Newton, Faraday, Darwin and others. An alternate topic might be writing about science and technology for the modern, educated lay audience. Works might be examined for the importance of the technological and scientific developments they cover, for their relation to views about science and technology in modern America, and for the authors' importance as stylists.

ENG 3359 Writing Workshop

This course is designed to provide advanced training in varied forms of writing. In different years, the topics could be such specialized areas as fiction, poetry, professional writing, and writing for academic administrators. In this course, intensive writing will be expected by the student and extensive comment by the professor.

ENG 3360 Writing Workshop

This course is designed to provide advanced training in varied forms of writing. In different years, the topics could be such specialized areas as fiction,

poetry, professional writing for academic administrators. Intensive writing will be expected by the student and extensive comment by the professor.

ENG 3361 Topics in Literary Study

Varied topics will deal with literature on a thematic, formal, or generic basis. Some possible topics might be: Literature in the Jazz Age, The Tragic Hero, The Poetry of Nature. Topics will vary from year to year.

ENG 3380 Prose Writing I

This is a course in the writing of various types of nonfiction prose, including reviews, reports, biography, commentary, research, personal narrative, travel, and others developed by the participant in consultation with the instructor. The course will focus on concepts of content, point of view, organization, style, and stages of composition.

ENG 3381 Prose Writing II

This course continues Prose Writing I. The goal of the course is to reinforce writing theory and practice, to introduce the professional concerns of writers, and to prepare writing for possible publication. Participants will refine techniques of composition and will examine the rhetorical methods of description, narration, exposition, and persuasion. The course will review such writers' markets as newspapers, popular magazines, and scholarly journals. When possible, professional writers will be featured as guest speakers.

ENG 3384 Rhetorical Theory

This course will trace the history of rhetoric and examine the major contemporary theories in the field. Consideration will begin with the classical rhetoric of Aristotle, Plato, Cicero, and Quintilian and end with the modern formulations of rhetoric by I.A. Richards, Philip Wheelwright, Alexander Bain, James Moffett, and James Kinneavy.

Rhetoric will be examined in terms of traditional modes of classifying discourse—description, narration, exposition, and persuasion—as well as modern reclassifications—expressive, referential, literary, and other modes. The course will also review rhetorical strategies for invention in the composing process: Burke's dramatic method, Rohman's prewriting, and Pike's tagmemics.

ENG 3385 Writing about Literature and Other Disciplines

This course will examine some characteristic student and professional writing in the humanities, sciences, and social sciences.

The goal of the course is to help participants see how students can use writing as a way of knowing and learning, not just in the English class but, for example, in the biology, history, or even mathematics class as well.

This course will focus on selected readings from relevant professional journals, popular magazines, and textbooks. Participants will analyze the

content, style, and rhetorical method of these materials, as well as review writing tasks common to the disciplines.

ENG 3386 Research in Composition

The goal of this course is to prepare publication of research by providing a working knowledge of sources, current scholarship, and standards of publication. To this end, the course will acquaint participants with various bibliographies, journals, texts, and monographs that constitute the important documents of the field. Participants will use these documents to pursue research topics in invention, structure and form, modes of discourse, the composing process, and pedagogy.

ENG 3387 Case Study Design

This course will prepare participants for research to be conducted in Field Work during the academic year at the home institution. Participants will examine some published case studies of teaching and writings, and will explore relevant methods of data analysis, observation techniques, interview and questionnaire construction, sampling procedures, experimental design, and writing protocol analysis.

ENG 3388 Field Work

During the academic year, participants will conduct the independent research planned in Case Study Design.

The resources available for this research at the home institution will include the participants' individual teaching practices, course or departmental curriculum, the writing of their students and of students in other classes, the practices of other teachers and administrators, as well as published books, reports, and articles on composition. They will collect, collate, and interpret data according to the guidelines established at the Institute. They will then prepare a project in which they present their findings.

ENG 3389 Case Study Analysis

Participants who have prepared Field Work projects will present their findings, draw their conclusions, and discuss the implications of their research for further study. Participants will be guided toward possible publication of their work in relevant composition journals.

This course concludes the Case Study Design, Field Work, and Case Study Analysis sequence.

ENG 3400 English Grammar

Methods and analytic procedures (but not the formalism) of modern linguistics are used to justify and support categories, distinctions, and structure used to describe sentences. These categories, distinctions, and structures will come mainly from the framework of traditional grammar. However, the inconsistencies and arbitrariness common in traditional grammar will be replaced by modern analyses, informally presented.

ENG 3401 Semantics

The relation between language and behavior; the concept of change, variety, and uniqueness; symbols, levels of abstraction, habits of evaluation of linguistic phenomena; representation of meaning in language.

ENG 3402 History of the English Language

Topics include the development of the sound system from Old English to the present; changes in the inflectional system and corresponding developments in sentence structure; processes of word formation and shifts in meaning. Poetry, prose, and nonfictional readings supplement the text.

ENG 3403 Topics in Linguistics

Subject to be announced.

ENG 3404 Language and Its Structure

Introduction to the study of language, the principles and methods of linguistic description; the development of the science of language, of descriptive and generative linguistics. Emphasis on goals of modern linguistic theory.

ENG 3405 Descriptive Linguistics

Intonation (stress, pitch, juncture); phonemics; morphemes and morphology; syntactic devices; the process of communication; variation in speech.

ENG 3406 Transformational and Generative Grammar of English

Deep and surface structures and transformations necessary to generate the latter; graphic representations of structure; deep-structure nature of adjectives, pronouns, prepositions, auxiliaries, possessives, comparison with traditional grammar.

ENG 3407 Children's Literature

A study of history and major forms of children's literature in the English language. The course covers such topics as folktales and folklore, novels, poetry, and informational books and includes cultural and sociological theories of childhood and adolescence.

ENG 3408 Literature and the Visual Arts

Examination of the complex relationships between literature and visual arts. Consideration of such topics as theoretical approaches to this relationship, the work of painter-poets, verbal descriptions of art (e.g., poems about paintings), works in which verbal and visual art are integrated. The course is organized by issues rather than historically. Each student is expected to work on an individual project. Field trips are included as part of the course.

ENG 3409 Literature and Psychology

An examination of theoretical positions and practical problems in the relationships between literature and psychology. Psychological interpreta-

tions of lyrics, works of fiction, and dramas are examined. In addition to the selected essays on certain literary works, several theoretical texts are studied.

ENG 3410 Short Fiction

The short stories of Sherwood Anderson and Ernest Hemingway and their contribution to American literature.

ENG 3411 Comic Drama

The Comic Spirit and its manifestations in dramatic literature and performance. The nature and forms of comic playwriting from Aristophanes to the present. An examination of the theater's comic forms: farce, comedy, satire, parody.

ENG 3412 Tragic Drama

This course considers important theories of tragedy and certain plays in an effort to consider the relation, if any, which exists between theory and practice of the tragic genre.

ENG 3413 Humor in American Literature

An account of American humorous writing from 1830 to the present. Various types of literary humorists are studied, such as Artemus Ward, Mark Twain, George Harris, and others. Some attention also to such modern humorists as Thurber.

ENG 3414 Satire

A theoretical study of satiric forms—Roman, renaissance and neoclassical verse satire, and later satiric narratives. Writers surveyed can include Horace, Juvenal, Pope, Swift, Voltaire, Byron, Evelyn Waugh.

ENG 3415 Literary Impressionism

Intensive study of this theory of impressionism (with some attention to music and painting as well as literature) and its role in literary history. Readings explore French, British, Scandinavian, and American writers, especially Crane, Ford, Conrad, James, Moore, Hemingway, and Faulkner.

ENG 3550 Classical Backgrounds

Readings in translation of Greek and Roman literature pertinent to the study of English and American literature. Focus upon the development of genre and theme.

ENG 3551 Chaucer's *Troilus and Criseyde*

A detailed examination of the poem.

ENG 3552 Chaucer's *Canterbury Tales*

Selected *Canterbury Tales*.

ENG 3553 Middle English Lyrics and Drama

A study of the epic and romance, concentrating on the transformation of the epic to the courtly hero: works to include in translation *Beowulf*, *Chretien de Troyes*, the *Nibelungenlied*, and *le Morte D'Arthur*.

ENG 3554 Studies in Fourteenth-Century Literature

Major works in non-Chaucerian Middle English including *Sir Gawain and The Green Knight*.

ENG 3555 Tudor Poetry

Wyatt and Surrey, Sidney, Marlowe, Spenser, Shakespeare: the poems of courtly love and the reaction against it.

ENG 3556 Renaissance Drama

Twelve representative Elizabethan and Jacobean comedies and tragedies.

ENG 3557 Shakespeare's Histories

The English history plays from *Richard III* to *Richard V*, plus *Titus Andronicus*, *Julius Caesar*, and *Troilus and Cressida*.

ENG 3558 Shakespeare's Tragedies

Eight plays from *Richard II* to *Antony and Cleopatra*.

ENG 3559 Shakespeare's Comedies

Eight plays from *Comedy of Errors* to *The Tempest*.

ENG 3560 Problems of Shakespearean Interpretation

A study of various "problematic" plays; a general knowledge of Shakespearean drama and the sonnets is presumed.

ENG 3561 Seventeenth-Century Literature

Major prose and poetry of the seventeenth century, excluding drama: Bacon, Hobbes, Browne, Bunyan, Donne, Herbert, Johnson, Marvell, and others.

ENG 3562 Milton's Major Poetry

Milton's poetic and intellectual achievement is studied through analysis of his major works. Particular emphasis is given to *Paradise Lost* as an expression of Renaissance humanism and the culmination to the epic tradition.

ENG 3563 Restoration and Early Eighteenth-Century Literature

A critical study of neoclassical drama, poetry, and criticism; Restoration drama, Dryden, Pope, Addison, Steele, and Gay.

ENG 3564 Age of Johnson

Johnson, Boswell, and the Club: Burke, Goldsmith, and Gibbon; poetry of Cowper, Gray, Burns, and Smart.

ENG 3565 Topics in Augustan Literature

Subject to be announced.

ENG 3566 Eighteenth-Century Fiction

Novels by Defoe, Fielding, Richardson, Smollett, Sterne, and Austen.

ENG 3567 Individual Eighteenth-Century Novelist

Subject to be announced.

ENG 3568 Romantic Poetry I

A study of the first generation of British poets (Blake, Wordsworth, Coleridge) whose concern for individual dignity and imaginative freedom came to be characterized as Romanticism.

ENG 3569 Romantic Poetry II

Second generation of British Romantics: Byron, Keats, Shelley.

ENG 3570 Topics in Romanticism

Romantic attitudes toward mankind in relation to self, society, and the universe, and Romantic attitudes toward the individual person as poet, with the impact these attitudes have upon the form and thematic substance of authentic and fictional autobiography in poetry and prose. May include an intensive reading of one major British writer whose attitudes, themes, style, and philosophy are representative of the Romantic Era (1794–1832).

ENG 3571 Victorian Literature

General survey touching upon major genres in Victorian literature with emphasis on the transition from the Victorian to the "modern," including such writers as Carlyle, Ruskin, the Brontës, Swinburne, Pater, Wilde.

ENG 3572 Victorian Poetry

A close study of Tennyson, Browning, Arnold; also the pre-Raphaelite circle and the movement toward modernism: D.G. Rossetti, Swinburne, G.M. Hopkins.

ENG 3573 Victorian Novel

Close study of major works by Dickens, Eliot, the Brontës, Hardy.

ENG 3574 Individual Victorian Novelist

Subject to be announced.

ENG 3575 Topics in Victorian Literature

Subject to be announced.

ENG 3576 Twentieth-Century British Literature

Theme and structure in the work of several dramatists from Shaw to Osborne and of several novelists from Conrad to Anthony Powell, with an emphasis on major trends in the novel and in drama during the present century.

ENG 3577 Early Twentieth-Century British Poetry

Twentieth-century poets whose work has shaped and established the modern tradition or extended our understanding of the traditions of the past: Hardy, Yeats, Lawrence, Muir, Auden, Owen, Thomas.

ENG 3578 Contemporary British Poetry

A seminar concentrating on the main currents in British poetry since 1945, including an examination of the later work of the poets of Auden's generation as well as such writers as Philip Larkin, Edwin Muir, William Flomer, A.D. Hope, Basil Bunting, and others, especially those younger writers whose work represents a break with established traditions.

ENG 3579 Individual Modern British Poet

Subject to be announced.

ENG 3580 Twentieth-Century British Fiction

Major figures of the modern and the contemporary periods: Conrad, Joyce, Cary, Beckett, Braine, Fowles, Snow, Lawrence, Woolf, Murdoch, Lessing, Huxley.

ENG 3581 Individual Modern British Novelist
Subject to be announced.**ENG 3582 Twentieth-Century Irish Renaissance**

A study of the emergence of a distinctive Irish literary tradition through concentration on the work of the main figures of the Irish literary revival, with particular emphasis on Yeats, Joyce, Synge, and O'Casey; minor concentration is on post-Revolutionary and contemporary Irish writers: O'Faolain, O'Connor, and Behan.

ENG 3583 Early American Literature

A survey of American literature during its first two centuries, from the puritans to the Knickerbockers, from William Bradford to James Fenimore Cooper.

ENG 3584 Literature of the Early Republic

The beginning of the American literary tradition in poetry, prose, fiction and drama: Freneau and Bryant, Bartram and Irving, Browne and Cooper, Tyler and Dunlap.

ENG 3585 Nineteenth-Century American Literature

A critical examination of selected works of prose and poetry by major writers of the period: Poe, Hawthorne, Melville, Thoreau, Dickinson, and Longfellow.

ENG 3586 American Literature 1830–1865

Subject to be announced.

ENG 3587 Nineteenth-Century American Poetry

Subject to be announced.

ENG 3588 The Romance in America

An attempt to define the American Romance through the study of Cooper's Leatherstocking novels, the major novels of Hawthorne, and Melville's *Moby Dick* and *Billy Budd*.

ENG 3589 The Rise of Realism

An examination of local colorism, realism, and naturalism in the works of Twain, Howells, James, Dreiser, Norris; and readings in European realism.

ENG 3590 Literature of the American South

A study of the southern literary experience from early nineteenth century to mid twentieth, from Simms to Faulkner.

ENG 3591 Twentieth-Century American Poetry

Twentieth-century poets who have struggled to establish a tradition for American poetry and whose examples have dominated poetry up to the present: Robinson, Frost, Stevens, W.C. Williams, M. Moore, Eliot, Pound, Crane, Cummings, and the Fugitives.

ENG 3592 Modern American Drama

Philosophic and aesthetic trends among such playwrights as O'Neill, Williams, Miller, Albee, Simon, and others.

ENG 3593 Individual Modern American Poet

Subject to be announced.

ENG 3594 Modern American Novel

Subject to be announced.

ENG 3595 Individual Modern American Novelist

An in-depth examination of the work of a major figure in American fiction, focusing on the cultural context out of which he or she emerges. Recent selections for this course have been Hemingway, Fitzgerald, Mailer, Faulkner, and Bellow.

ENG 3596 Individual American Writer

Subject to be announced.

ENG 3597 Contemporary American Poetry

Subject to be announced.

ENG 3598 Twentieth-Century American Fiction

Adams, Dreiser, Crane, Dos Passos, Fitzgerald, Cozzens, Faulkner. The beginnings and development of modern American fiction.

ENG 3600 Nineteenth-Century European Novel

Examination of major novelists and major literary movements in nineteenth-century Europe. Discussion of such novelists as Balzac, Stendhal, Huysmans, Flaubert, Dostoevski, Turgenev, and Hardy.

ENG 3601 Thesis

Six quarter-hours maximum; by arrangement.

ENG 3602 Independent Study

By arrangement.

History

All courses carry three quarter-hours of credit except seminars, which carry four quarter-hours, and other courses where noted.

HST 3241 Methodology

The objectives, methods, and resources of the historian.

HST 3242 European Historiography

The development of historical writing from ancient times to the present.

HST 3243 American Historians

The writing of American history by Americans, from colonial times to the present, with emphasis on changes in both form and substance.

HST 3301 Ancient Greece (Group I)

Selected topics in the history of ancient Greece.

HST 3302 Ancient Rome (Group I)

Selected topics in the history of Rome in the period of the Republic or the Empire.

HST 3306 The Renaissance (Group I)

European political and cultural life from the thirteenth to the seventeenth centuries, with attention to humanism and to the rebirth of classicism in literature and the arts.

HST 3307 The Reformation (Group I)

The development of the Christian Church from the thirteenth to the seventeenth centuries, with attention to the conflict between church and state, the impact of the Renaissance, the rise of the Protestant sects, and the wars of religion.

HST 3310 Intellectual History of Europe, 1688-1789 (Group I)

The broad spectrum of eighteenth-century thought, with emphasis on scientific, religious, and political ideas.

HST 3311 Intellectual History of Europe, 1789-1870 (Group I)

The great age of liberal and nationalistic thought. Social problems created by industrialism and various proposals to solve these problems are examined.

HST 3312 Intellectual History of Europe, 1870-1950 (Group I)

The intellectual developments which have brought Europe to its present position in world affairs. Topics considered include theories of evolution, scientism, radical socialism, and fascism.

HST 3315 Diplomatic History of Europe, 1815-1914 (Group I)

The foreign policies of the chief European powers, with emphasis on changing alliances and alignments, imperialistic rivalries, and efforts at international cooperation.

HST 3318 Imperialism (Group I)

The rise and development of colonial empires with emphasis on the 19th century. The nature of empire, motives for imperial expansion, and the colonial heritage.

HST 3320 Twentieth-Century Europe (Group I)

The political history of Europe since 1900, with attention to World War I, the rise of communism and fascism, the struggle for security in the western democracies, World War II, and the Cold War.

HST 3322 Socialism and Revolution (Group I)

Studies in the history of socialism and revolution from the early nineteenth-century utopias to the New Left of the 1960s.

HST 3330 Britain, 1688-1815 (Group I)

Topics include constitutional evolution, political parties, social and economic change, religious and intellectual developments, cultural achievements, and Scotland and Ireland.

HST 3331 Britain, 1815-1914 (Group I)

Aspects of nineteenth-century Britain, including reform of Parliament, liberalism and socialism, the Irish question, imperialism, and Victorian ideas and attitudes.

HST 3332 Britain since 1914 (Group I)

A social and political history with emphasis on the manner in which incompetent leadership and futile class struggle contributed to Britain's failure as a world power.

HST 3339 The Modernization of Ireland (Group I)

Analysis of themes in the growth and development of modern Ireland. Topics examined include migration and its effects on a traditional society, the role of religion in the assertion of national independence, and modernization within the British nexus.

HST 3345 Hitler's Germany (Group I)

A study of the history of the Third Reich, including an in-depth analysis of the process by which the political motives and methods of the Nazis ultimately won the support of the German people.

HST 3370 Family History (Group I or II)

An examination of the history of the family in Europe and America from the *ancien regime* to the present with attention to demographic issues and trends, industrialization and the family, women's roles, child-rearing practices, the changing nature of marriages and divorce, and life cycle and aging.

HST 3380 Seminar in the Renaissance (Group I)

Research and writing concerning the Renaissance.

HST 3381 Seminar in the Reformation (Group I)

Research and writing concerning the Reformation.

HST 3382 Seminar in European Intellectual History (Group I)

Research and writing on special topics in European intellectual history.

HST 3383 Seminar in Nineteenth-Century Europe (Group I)

Research and writing in European history from 1850 to 1900.

HST 3384 Seminar in Twentieth-Century Europe (Group I)

A study of a selected controversy in contemporary European history.

HST 3385 Seminar in European Social History (Group I)

Focusing on Britain, France, and Germany in the nineteenth and early-twentieth centuries and looking at history "from below," this course examines comparative issues in European social history. Topics include the nature of social protest, the rise of organized labor, and the impact of war and revolution on the lives of ordinary people.

HST 3386 Seminar in Imperialism (Group I)

An inquiry into the motives underlying European expansion in the late nineteenth century.

HST 3387 Seminar in Nineteenth-Century Britain (Group I)

Selected topics for research and writing with special emphasis on the social effects of industrialization.

HST 3388 Seminar in Twentieth-Century Britain (Group I)

Selected topics for research and writing.

HST 3389 Seminar in Modern France (Group I)

Research, writing, and collective analysis of several themes in modern French social history since 1789, including the role of social class in revolutionary protest, industrialization, technology and modernization, the rise of the working class and the development of organized labor, the French peasantry in an industrial society, the nature of the family, and women's roles.

HST 3390 Seminar in Russian History (Group I)

A narrow period or special topic in Russian history. *The course presupposes a basic knowledge of Russian history and requires extensive work on a research paper.*

HST 3397 Seminar in Comparative Labor History

Analysis of issues in the history of the European labor movement, focusing on 19th and 20th century Britain, France, and Germany. Issues include: the meaning of the concept of class in labor history; labor movements and politics (working-class conservatism and working-class radicalism); the place of women in the working class and in the labor movement; worker responses to mechanization, automation and scientific management in the 20th century.

HST 3399 Seminar in Approaches to Women's History (Groups I, II, or III)

Study focuses on current issues in women's history and the methods historians use to study women's historical roles in the market place, work force, political arena, and domestic scene in Europe, Asia, the United States, and Latin America. Emphasis is on the importance of comparative and interdisciplinary approaches to the history of women. The seminar includes lectures and discussions with specialists using various approaches, assigned reading, and an independent project.

HST 3404 Colonial America: The Seventeenth Century (Group II)

Exploration of the New World, settlement of the English North American mainland colonies, and the adaptation of European institutions and ideas to New World conditions.

HST 3405 Colonial America: The Eighteenth Century (Group II)

The expansion of the English colonies in the New World, the development of political and social institutions, and the sources of friction with England to 1763.

HST 3407 The American Revolution (Group II)

Topics in the history of the American Revolution from 1763 to 1783.

HST 3410 Topics In American Reform (Group II)

Selected studies of movements to change aspects of American society.

HST 3413 Topics in the Civil War and Reconstruction (Group II)

Analysis of key issues surrounding the events leading up to the Civil War, the war itself, and the Reconstruction period.

HST 3420 Public Life in Nineteenth-Century America (Group II)

Analysis of public policy and policy making; governmental structure, relations, and ideology; and electoral systems, viewed in long-run perspective.

HST 3421 Political Change in Twentieth-Century America (Group II)

Analysis of the growth of governmental function and structure, emphasizing the evolution and administration of leading policy concerns of the current century, changes in federalism and intergovernmental relations, and patterns of popular political participation and thinking.

HST 3423 The Age of Roosevelt (Group II)

An analysis of the foreign and domestic policies and programs of the four Roosevelt administrations, set within the context of the world-wide depression and global war. Emphasis is on the range of recent interpretations and analytic methods used in evaluating the place of Roosevelt in American history.

HST 3434 American Social History, 1900-1950 (Group II)

The transformation of the naive and idealistic America of the early twentieth century to life in a world in which technology has far outstripped man's mental and moral capacity to cope with it.

HST 3440 African-American History I (Group II)

The history of African-Americans to 1900, with emphasis on the role of black people in slavery and freedom.

HST 3441 African-American History II (Group II)

The history of African-Americans since 1900.

HST 3442 New Perspectives on American Slavery (Group II)

An in-depth examination of slavery in the Americas. Special emphasis will be placed on the impact of the slave trade; the development of slavery as an institution; the impact of slavery on the black family; the key role played by the black church; black resistance to slavery; the historiography of slavery, especially the two decades of reaction to the still-controversial thesis of Stanley Elkins; and slavery from a comparative perspective, contrasting slavery in Latin America and the United States.

HST 3450 Boston as a City (Group II)

An in-depth examination of historic Boston from 1822 to the present. Emphasis is on Boston's early growth as a city, the Hub as a center of pre-Civil War reform, the coming of the Irish, Boston as America's Athens, the revolutionary shift from Yankee to Irish political domination, the flamboyant era of James Michael Curley, and the development of the "New Boston."

HST 3480 Seminar in American History (Group II)

Research and writing on selected aspects of American history.

HST 3481 Seminar in Colonial and Revolutionary America (Group II)

Research and writing on some topic in American history prior to 1789.

HST 3482 Seminar in American Governmental History (Group II)

Concentrated attention to a particular problem or theme in American governmental history, emphasizing individual student research and writing.

HST 3483 Seminar in American Urban History (Group II)

The political, economic, and social history of America's major cities, with special emphasis on Boston's last century.

HST 3484 Seminar in American Maritime History (Group II)

Examination of selected aspects of American maritime history. Possible topics range from early exploration to the age of nuclear propulsion and may include merchant and naval aspects of the subject.

HST 3485 Seminar in African-American History (Group II)

Research and writing on an aspect of African-American history.

HST 3486 Seminar in Recent American History (Group II)

Special topics from the period 1896 to the present studied in detail. Students are expected to present a research paper on a major person, action, or movement.

HST 3501 History of Exploration (Group III)

A comprehensive survey of exploration from ancient times to the present with emphasis on the motives for exploration and their impact on the regions discovered and on those doing the discovering.

HST 3503 Approaches to World History (Group III)

An interdisciplinary examination of the study of civilization emphasizing various methodologies and theories and testing them by studying specific historical periods and cultures.

HST 3505 Canada and the United States (Group III)

How and why a separate Canadian nation managed to emerge despite decades of American political and military threats. Examination also includes Canada's subsequent response to growing cultural and economic domination by the United States.

HST 3508 Modern Africa (Group III)

A topical approach to the history of Africa since 1850.

HST 3510 History of the Islamic Peoples (Group III)

A study of the history, culture, and religion of the followers of Muhammad from 600 to 1800.

HST 3512 Modern Middle East (Group III)

A study of the Middle East in the twentieth century.

HST 3523 Modern Japan (Group III)

The history of Japan since the fall of the Tokugawa, emphasizing political and economic developments, especially after World War II.

HST 3529 Communism in China (Group III)

A study of the Chinese Communist movement from its origins in the 1920s to the present.

HST 3531 Population in History (Group III)

An application of demographic theory to history.

HST 3533 Psycho-History (Group III)

An introduction to the concepts, scholarship, problems, and directions of psychohistorical studies.

HST 3540 Economic History of the Modern Western World (Group III)

Topical analysis of the economic development of the modern Western world.

HST 3601 Historical Administration (Group III)

The administration of historical agencies with attention to problems of finance and personnel and to the legal-governmental environment in which agencies operate.

HST 3602 Historical Societies and Archives (Group III)

The varieties of historical societies (local, state, and national) and the kinds of private (business, college, church) and public (local, state, and national) archives; their activities and procedures; their similarities and differences.

HST 3603 Historical Exhibits and Museums (Group III)

Approaches, techniques, and special problems in the presentation of history to the public through exhibits, films, and other audiovisual and written media. Guest lecturers from the field present lectures, and students have the opportunity to gain practical experience.

HST 3605 Historical Editing (Group III)

A laboratory for the study and practice of historical editing. Students are introduced to the major collections of edited papers and instructed in editing historical documents. Each student is given an historical document to prepare for publication. Instruction also covers the editing of history books and journals.

HST 3610 Industrial Archeology (Group III)

An introduction to the history, practice, and place of industrial archeology. There will be examination of techniques and procedures used to unearth the industrial past. Field trips to local industrial sites will be taken.

HST 3611 Historic Preservation (Group III)

An introduction to historic preservation, with attention to the history, the philosophy, and the practical problems of preservation.

HST 3620 Oral History (Group III)

The theory and practice of creating, processing, and using primary source material obtained by taping interviews with people whose role in history would otherwise go unrecorded.

HST 3621 Genealogical Research: Methods and Uses (Group III)

An analysis of the tools and sources available to genealogists and historians with attention to historical applications of such data. Students will have opportunity to use various records essential to the writing of family history.

HST 3622 Local History Methodology (Group III)

An examination of the development and uses of local history with special attention to the methodological aspects of this burgeoning field. Publications of local historical societies and museums will receive particular attention.

HST 3625 Media and History (Group III)

Students will have the opportunity to explore such topics as the advantages and drawbacks of specific media, the uses and abuses of media in research and teaching, and the construction of media. Each student is required to participate in a research project involving the creation and/or evaluation of historically valid films, slide tapes, and other materials.

HST 3798 Master's Thesis Continuation 0 Q.H.**HST 3805 Assigned Reading 1 Q.H.**

Assigned reading under supervision of a faculty member.

HST 3811 Thesis 9 Q.H.

Thesis supervision by members of the department.

HST 3821 Fieldwork in History I 4 Q.H.

Fieldwork offers students the opportunity to get practical experience in historical agencies (in-

cluding historical societies, archives, museums, exhibits, restorations, preservation projects, and the like). Students are required to work in the agency eight to ten hours a week for one quarter under the direction of an agency supervisor and departmental adviser.

Law, Policy and Society

Core Courses

ECN 3210 Microeconomics

(Economics, 4 Q.H.)

This course addresses the basic question of resource allocation within our society, a question central to issues concerning the appropriate role of government intervention in the private economy, the efficiency and equity of public expenditure-regulation programs, and the costs imposed on society by various activities that are unregulated or uncontrolled. A more detailed description of this course can be found in this catalogue under "Description of Courses for the Economics Department."

INT 3249, 3250 Law, Policy, and Society Survey (Interdisciplinary, 4 Q.H.)

This course is intended to offer students the opportunity to form a foundation derived from several disciplines in the range of methodologies and perspectives that are employed in the study of law and society. Among topics to be examined are issues such as normative vs. formative functions of law, social control vs. individual freedom, and legal bases of conflict management in society. Although the course is coordinated by one instructor, faculty affiliates of the program participate in

HST 3822 Fieldwork in History II

4 Q.H.

A second opportunity for students to acquire practical experience in an historical agency. The fieldwork placement requires eight to ten hours a week for one quarter under the direction of an agency supervisor and a departmental adviser.

the course, permitting approaches and specific content to be presented by and discussed from a variety of informed perspectives.

LAW 2364 Legal Research and Bibliography

(Law, 1 Q.H.)

This course is open only to students in the Law, Policy and Society Program. It is designed to introduce them to the resources and the use of the Law Library and the basic techniques of legal research.

SOC 3113 Introduction to Research Methods

(Sociology, 2 Q.H.)

An introduction to methods of social research including field study and participant observation techniques, survey techniques, interviewing and questionnaire construction, sampling procedures, experimental design, content analysis, and uses of available data. Open only to Law, Policy and Society students.

SOC 3114 Introduction to Quantitative

Research Methods

(Sociology, 2 Q.H.)

An introduction to quantitative techniques of analysis. Students are expected to conduct individual research projects. Open only to Law, Policy and Society students. *Prep.: SOC 3113 or its equivalent.*

Mathematics

The following courses are offered for those who wish to enter the master's degree program in mathematics, but who fail to satisfy the admission requirements. These courses are taken in addition to the required course work in mathematics.

MTH 3001, MTH 3002, MTH 3003 Abstract

Algebra I, II, III

2 Q.H.

Groups, subgroups, normal subgroups, rings, ideals, integral domains, and fields. *Prep.: Differential and integral calculus.*

MTH 3004 Advanced Calculus I

2 Q.H.

Functions of one independent variable; limits, continuity, differentiability properties of continuous functions on a closed bounded interval. Rolle's theorem and the mean-value theorem. *Prep.: Differential and integral calculus.*

MTH 3005 Advanced Calculus II

2 Q.H.

Functions of several independent variables. Distance and open sets, limits continuity. Properties of continuous functions on a closed bounded set. Differentiability and differentials, mean-value

theorem, implicit function theorems, Jacobians and transformations. *Prep.: MTH 3004.*

MTH 3006 Advanced Calculus III

2 Q.H.

Sequences, sequences of functions, uniform convergence, series. Integration, line and surface integrals. *Prep.: MTH 3005.*

MTH 3011 A First Course in Mathematical

Logic

2 Q.H.

Propositional calculus, quantificational logic, first order theories through the Skolem-Lowenheim Theorem.

MTH 3012 An Introduction to Recursive

Function Theory

2 Q.H.

Turing machines. Partially computable functions. Firmative recursive and general recursive functions and predicates. Unsolvable decision prob-

lems. Recursively enumerable sets to integers. The unsolvability of Hilbert's Tenth problem.

MTH 3013 Godel's Incompleteness Theorem **2 Q.H.**

Formal number theory. Arithmetization. Godel's First and Second Incompleteness Theorems for formal number theory. *Prep.: A knowledge of the methods of mathematical logic.*

MTH 3014 Set Theory **2 Q.H.**

The informal study of sets, including detailed discussion of the axiom of choice, well-ordered sets, and transfinite arithmetic.

MTH 3015 Formal Set Theory **2 Q.H.**

Versions to axiomatic set theory. The consistency of the continuum hypothesis and the axiom of choice. As time permits, the independence of the continuum hypothesis and the axiom of choice. *Prep.: The equivalent of 10.8k2 and MTH 3014.*

MTH 3101 Analysis I **4 Q.H.**

Basic topic in analysis and topology, including metric spaces and normed linear spaces; continuity; compactness; completeness; differentiability; function spaces; polynomial approximations. *Prep.: Advanced calculus.*

MTH 3102 Algebra I **4 Q.H.**

Emphasis on group theory and linear algebra, including definition of rings and modules. Groups: subgroups, cyclic groups, cosets, Lagrange's Theorem, normal subgroups, homomorphisms and automorphisms, permutations (cycle decomposition, parity, conjugacy classes). First and second isomorphism theorems, class equation, Sylow subgroups, direct products, finitely generated abelian groups. Linear algebra: bases and dimension, correspondence between linear transformations and matrices, systems of linear equations, row reduction, rank, determinant inner products. Gram-Schmidt; dual spaces; eigenvalues and eigenvectors; characteristic polynomial; minimal polynomial; spectral theorem for symmetric, hermitian, and unitary matrices,

MTH 3103 Analysis II **4 Q.H.**

Complex function theory, including the method of residues; evaluation to series and integrals; differential forms.

MTH 3104 Algebra II **4 Q.H.**

Finite extensions of fields, automorphisms, structure of finite fields, normal and separable extensions, Galois group, Fundamental Theorem of Galois Theory, cyclotomic fields, solvability of equations by radicals.

MTH 3105 Topology I **4 Q.H.**

General topological spaces. Compactness and connectedness. Separation properties. Products. Complete metric spaces. Baire category theorem. Quotient spaces. Function spaces. Elementary homotopy. Some of the functorial viewpoint.

MTH 3106 Analysis III **4 Q.H.**

Lebesgue measure and integration, convergence theorems. Applications to probability theory and Fourier series.

MTH 3107 Topology II **4 Q.H.**

Simplicial complexes, manifolds. Classification of surfaces. Orientation. Euler characteristic. Vector fields. Mod 2 degree to a map. Linear group manifolds. Fundamental groups, covering spaces. Seiter-Van Kampen Theorem. Fundamental group of surfaces.

MTH 3221 Biostatistics **2 Q.H.**

Methods of statistical inference with applications to biology and the medical sciences.

MTH 3222 Applied Statistics **4 Q.H.**

Level to measurement, central tendency, dispersion, relatedness and significance to differences, analysis of data through correlation, regression, F-test, Chi square tests, T-test, analysis of variance and analysis of covariance. These analyses are accomplished using computer-based statistical subroutine packages. *Not for math graduate credit.*

MTH 3231 Introduction to Computer Programming and Applications **4 Q.H.**

This course is intended for graduate students in sciences, social sciences, and humanities who need to understand how computers can help solve problems in their fields of study. After instruction in the basics of computer programming and algorithm development, students are introduced to examples of the computers used in different areas of human endeavor. Students are required to write programs in BASIC programming language and run them on a computer. *This course cannot be taken for credit by graduate students in the Mathematics Department.*

MTH 3302 Constructive Algebra **4 Q.H.**

A constructive development of some of the old familiar areas of algebra: principal ideal domains, Dedekind domains, factorial domains, Noetherian rings.

MTH 3303 Set Theory **4 Q.H.**

First part: Informal study of sets, including detailed discussion of the axiom of choice, well ordered sets, and transfinite arithmetic. Second part: versions of axiomatic set theory. The consistency of the continuum hypothesis and the axiom of choice. As time permits, the independence of the continuum hypothesis and the axiom of choice.

MTH 3305, MTH 3306 Philosophy of Science and Mathematics I, II **4 Q.H. each**

Topics may vary from year to year. Past subjects have included the foundations of statistical inference, the structure of scientific theories, and analysis of the conceptual structure of mathematics.

MTH 3311 Mathematical Logic 4 Q.H.

This course combines material of MTH 3011 and MTH 3013.

MTH 3321 Algebra III 4 Q.H.

Rings, ideals, factor rings, prime and maximal ideals, principal and ideal domains, polynomial rings, unique factorization and Gauss' Theorem, modules, Hilbert Basis Theorem, Noetherian rings and modules, Artin rings, matrix rings, Wedderburn's structure theorem for simple Artin rings, exact sequences, tensor products.

MTH 3331 Homological Algebra 4 Q.H.

Basic properties of categories and functors; sums, products, morphisms; Hom, Tensor product, and their derived functors Ext and Tor; exact sequences, homology and co-homology; homological dimension and co-dimension; applications to algebra and topology.

MTH 3332 Commutative Algebra 4 Q.H.

Prime ideals, localization, integral extensions; primary decomposition; Krull dimension; chain conditions, Noetherian and Artinian modules; additional topics from ring and module theory as time permits.

MTH 3341 Applied Mathematics I 4 Q.H.

Deterministic models in the physical and life sciences. Regular and singular perturbation: dimensional analysis; linear and nonlinear boundary layer problems; WKB theory; multiple scale analysis; qualitative analysis in phase science; singular perturbation of PDEs, asymptotic analysis.

MTH 3342 Applied Mathematics II 4 Q.H.

Partial differential equations and modeling. Method of characteristics; shock waves; conservation laws; Fourier series, parabolic, hyperbolic, and elliptic equations; generalized Fourier transforms; first order systems; the Cauchy-Kowalewski theorem; well-posed problems; recent applications to scientific problems.

MTH 3351, MTH 3352 Ordinary Differential Equations I, II 4 Q.H. each

Topics in ordinary differential equations. *Prep.: Elementary Ordinary Differential Equations.*

MTH 3356 Calculus of Variations 4 Q.H.

Euler's equation for extremals; classical examples, isoperimetric problems; necessary and sufficient conditions for an extremal to be a local minimum, applications to differential geometry, physics, and economics, Hamilton-Jacobi Theory, theory of the second variation.

MTH 3361 Numerical Analysis I 4 Q.H.

Solution to boundary value problems by the finite-element method; formulation of finite elements; application to interpolation, elliptic and parabolic differential equations, and eigenvalue problems; numerical solution of problems on a computer.

MTH 3362 Numerical Analysis II 4 Q.H.

Initial value problems: Runge-Kutta and multi-step methods, finite differences and finite elements.

MTH 3371 Optimal Control Theory I 4 Q.H.

Linear and nonlinear control problems defined by ordinary differential equations, relaxed controls, existence theorems, Pontryagin's maximum principle.

MTH 3373 Optimization 4 Q.H.

Convex sets, linear and nonlinear programming, zero-sum games, dynamic programming, numerical methods.

MTH 3380 Functional Analysis 4 Q.H.

Topological vector spaces, Banach spaces, Hilbert spaces, algebras of operators, representations.

MTH 3386 Lie Theory 4 Q.H.

Lie groups and Lie algebras. The exponential map. Examples, basic structure theorems. Representation theory. Applications. Additional topics vary with the instructor and may include infinite-dimensional Lie algebras, algebraic groups, finite groups of Lie type, geometry and analysis of homogenous spaces.

MTH 3395 Dynamical Systems 4 Q.H.

Structural stability and qualitative theory of dynamical systems.

MTH 3405 Algebraic Topology 4 Q.H.

Topics from homology groups, sequences; fiber spaces; sheaves; products in homology and cohomology; cohomology algebra; Kunnetheorems; cohomology operations; Poincaré duality; higher homology groups and the Hurewicz theorem; characteristic classes, spectral sequences.

MTH 3411 Differential Geometry 4 Q.H.

Geometry of surfaces in the Euclidean space, with emphasis on the global aspects, using the technique of tensor calculus. Elements of Riemannian geometry, connections. Holonomy.

MTH 3431 Probability I 4 Q.H.

Introduction to probability; independent random variables; types to convergence; laws of large numbers; characteristic functions, central limit theorem.

MTH 3432 Probability II 4 Q.H.

Introduction to stochastic processes; random walk; conditional expectations; Markov processes; multivariate normal distribution; Brownian motion.

MTH 3441 Statistics I 4 Q.H.

Parametric families of distributions; testing hypotheses; likelihood ratio tests; estimation and maximum likelihood, regression.

MTH 3443 Statistical Decision Theory 4 Q.H.

Subjective probability-utility. Bayesian approach to decision problems, including estimation, test-

ing hypotheses, and linear statistical models. Sequential decisions.

MTH 3444 Analysis of Variance 4 Q.H.
One-sample and two-sample tests; one-way ANOVA; factorial and nested designs; Cochran's theorem; regression; analysis of covariance; simultaneous confidence intervals.

MTH 3445 Topics in Statistics 4 Q.H.
Topics to be selected from multivariate statistics and clustering; categorical data, biostatistics; Stein's paradox and admissibility, foundations. May be repeated for credit.

MTH 3501 Data Structure 4 Q.H.
Basic structure for representing and manipulating data in computer programming: arrays, lists, stacks, queues, dequeues, trees, binary trees. Applications to nonnumeric computations. Searching and sorting. Students are required to write programs to implement these structures on a computer.

MTH 3502 Computer Organization and Programming 4 Q.H.
Computer organization; hardware and software components. Memory organization and addressing. Machine representation of data. Machine language and assembly programming. Subroutines and macros. Students are required to program several short exercises in assembly language and to undertake a term project at the end of the course.

MTH 3503 Compilers 4 Q.H.
Study of compilers; finite automata and lexical analysis; syntax specification; parsing; syntax-directed translation, symbol tables; run-time storage administration; error detection and recovery; code optimization, code generation. Students work as a team on a large programming project. *Prep.: knowledge of assembly language programming and some knowledge of data structures.*

MTH 3504 Systems Programming 4 Q.H.
Batch systems programs-assemblers, loaders, macro processors. I/O programming. Multiple processors and interrupt mechanisms. Addressing techniques and memory management. Processor management and job scheduling. Device management. Information management: file access, protection, and maintenance. *Prep.: MTH 3502, MTH 3501, or equivalent.*

MTH 3510 Data-Base Management 4 Q.H.
Components of data base. Hierarchical, network, and relational data-base systems. DBMS facilities: schema, subschema implementation considerations. Privacy, security, integrity, concurrency. Data directors. Distributed data bases. Comparison of available data-base management systems. *Prep.: A course in data structures.*

MTH 3512 Concurrent Programming 4 Q.H.
Programs that have several parts in execution at the same time. The logical problems that arise and

their machine implementations. Mutual exclusion, message passing, deadlock, monitors, kernels, and applications to operating systems. Programming is in the highest-level language available that supports concurrency.

MTH 3521 Theory of Automata and Formal Language 4 Q.H.
Finite-state machines and regular expressions, context-free grammars. Parsing of context-free languages. Context-sensitive grammars, push-down stores, stock machines, and linear-bounded automata. Turing machines, undecidability, description of computation using list-structures, program machines, and programs.

MTH 3522 Artificial Intelligence 4 Q.H.
Analysis of current computer programs dealing with problems such as theorem proving, chess playing, general problem solvers, robotics, symbolic computation, perceptions, self-reproducing automata, and parallel machines. *Prep.: A course in data structures.*

MTH 3525 Computer Communications System 4 Q.H.
Examples of networks such as ARPA and TYM-NET; link problems such as ARQ multiplexing and protocols; queuing theory; routing problems; flow-control and cryptography. *Prep.: A course in probability and statistics.*

MTH 3527 Combinatorial Theory 4 Q.H.
Various techniques of enumerative combinatorics, including binomial and multinomial theorems, principle of inclusion-exclusion, recurrence relation, generating functions. Stirling numbers. Special topics such as distributions, partitions, and polycounting theory are also covered. Topics in Matching Theory, including Hall's theorem. Marriage Problem and Rado's Selection Principle.

MTH 3528 Combinatorial System Analysis 4 Q.H.
Topics to combinatorial analysis closely related to computer and other finite systems. These include t-designs, athogonal Latin Squares. Difference sets and finite geometries. Algebraic coding is studied, including cyclic codes, Reed-Solomon Codes, BCH Codes, and Reed-Muller codes. *Prep.: One year of abstract algebra.*

MTH 3529 Graph Theory 4 Q.H.
Graphs and subgraphs; trees; connectivity; Euler tours and Hamilton cycles; matchings, edge colorings; independent sets and cliques; vertex colorings; planar graphs; directed graphs; networks, the cycle space and bond space.

MTH 3535 Algorithms and Complexity Theory 4 Q.H.
Data structures designed for efficient algorithms and for set manipulation problems such as lists, queues, stacks, binary search trees, and balanced tree schemes; algorithms on graphs such as

depth-first search, path-finding problems; matrix multiplication, fast Fourier Transforms, NP-complete problems, and some intractable problems. *Prep.: MTH 3527 Combinatorial Theory.*

MTH 3801 Seminar: Constructive Mathematics
4 Q.H.

MTH 3806 Readings in Algebra
up to 4 Q.H. per quarter

MTH 3807 Seminar in Algebra
up to 4 Q.H. per quarter

MTH 3811 Readings in Analysis
up to 4 Q.H. per quarter

MTH 3812 Seminar in Analysis
up to 4 Q.H. per quarter

MTH 3818 Seminar: Dynamical Systems
up to 4 Q.H.

Topics in dynamical systems as chosen by participants.

MTH 3821 Readings in Topology
up to 4 Q.H. per quarter

MTH 3822 Seminar in Topology
up to 4 Q.H. per quarter

MTH 3826 Readings in Statistics and Probability
up to 4 Q.H. per quarter

MTH 3831 Readings in Computer Science
up to 4 Q.H. per quarter

MTH 3836 Seminar in Combinatorics
up to 4 Q.H. per quarter

The department offers an assortment of courses under the general heading "Seminar" (MTH 3812-9). At the outset of each quarter, times for organizational meetings will be posted. Schedule and content are negotiated at these meetings. Students and faculty with interest in the specialty of the seminar are encouraged to attend the organizational meeting.

MTH 3850 Doctoral Dissertation

Physics

I. Introductory Courses

PHY 1305 Thermodynamics and Kinetic Theory
3 Q.H.

Topics include first and second laws of thermodynamics; entropy and equilibrium; thermodynamic potentials; elementary kinetic theory; statistical mechanics and the statistical interpretation of entropy.

PHY 1413 Introduction to Nuclear Physics
3 Q.H.

Topics include nuclear structure; nuclear masses; radioactivity-nuclear radiation; interaction of radiation and matter; detectors; fission, nuclear forces; elementary particles. *Prep.: PHY 1303 or equiv.*

PHY 1414 Introduction to Solid State Physics
3 Q.H.

This course offers a semiclassical treatment of the thermal, magnetic, and electrical properties of crystalline solids. Topics include X-ray diffraction and the reciprocal lattice; elasticity and lattice vibrations; specific heat; properties of insulators; magnetism in insulators and metals; introduction to the band theory of metals. *Prep.: 1 PHY 1305 and PHY 1303 or equiv.*

PHY 1415 Quantum Mechanics I 3 Q.H.

The first of a two-quarter sequence in quantum mechanics, this course focuses on observations of macroscopic and microscopic bodies, the uncertainty principle—wave-particle duality; probability amplitudes; Schrodinger wave theory; one-dimensional problems. *Prep.: PHY 1303 or equiv.*

PHY 1416 Quantum Mechanics II 3 Q.H.

A continuation of PHY 1415, this course covers discrete and continuous states; Schrodinger equation in three dimensions; angular momentum; general theory of quantum mechanics; applications. *Prep.: PHY 1415.*

PHY 3401 Radiation Physics 2 Q.H.

Introduction to atomic and nuclear physics for graduate students in biology and pharmacy. Topics include quantum mechanics and atomic structure, nuclear structure, radioactivity, properties of nuclear radiation, detection of radiation.

PHY 3402 Radiation Biology 2 Q.H.

The effects of radiation on biological systems and the uses of radiation in medicine and biological research. Topics selected from effects of radiation on chemical reactions; effects of radiation on cells, organs, and individuals; theories of radiation damage and repair; imaging and tracer techniques using radiopharmaceuticals; radiation safety and standards. *Prep.: PHY 3401 or equiv.*

PHY 3551, PHY 3552 Electronics for Scientists I, II 4 Q.H.

PHY 3551 and PHY 3552 form a two-quarter sequence covering electronic techniques for experiments research in many different fields of science. Topics include principles of semiconductor devices; analog techniques (amplification, feedback, integration), digital techniques (counting, multiplexing, logic); design of electronic subsystems (analog-to-digital converters, phase-sensitive detectors, data-logging systems); understanding specifications of commercial electronic equip-

ment. Lab examples make use of up-to-date integrated and discrete devices, such as are currently used in the electronic industry.

II. Required Regular Courses (offered every year)

PHY 3557 Graduate Advanced Laboratory

4 Q.H.

This course presents special projects in modern experimental physics, including electronic instrumentation used in measuring physical quantities and use of microprocessors. *Prep.: PHY 3551 and 3552 or permission of instructor.*

PHY 3561 Graduate Project Laboratory

4 Q.H.

This course allows students to select and carry out individual projects involving instrumentation and computation. The projects involve the development of some aspect of instrumentation and/or computation in an ongoing research project, and the preparation of a final report. The student will be supervised by the project leader and the course instructor. Although the course carries 4 q.h. credit, it is taken in successive winter and spring quarters. *Prep.: Permission of instructor.*

PHY 3601, PHY 3602 Mathematical Methods A, B

4 Q.H.

Calculus of variations. Euler-Lagrange equations. Mathematical methods in physics. Topics from theory of function of a complex variable. Analytic functions. Taylor and Laurent series. Analytic continuation and classification of functions. Calculus of residues. Asymptotic series. Dispersion relations. Applications to ordinary differential equations and the study of special functions. Finite and infinite dimensional vector spaces. Linear operators. Function spaces and generalized Fourier expansions. Green's functions and integral equations. Introduction to group theory.

PHY 3603 Classical Mechanics

4 Q.H.

Generalized coordinates and Lagrangian formulation of mechanics, conservation laws. One-dimensional and central force problems. Collision theory. Rigid bodies. Hamiltonian formulation and the canonical formalism. Continuous systems and classical fields.

PHY 3611, PHY 3612, PHY 3613 Electromagnetic Theory A, B, C

3 Q.H.

Maxwell's equations. Static field and boundary value problems, multipole expansion. Phenomenology of dielectrics, conductors, and magnetic materials. Faraday's Law. Energy and momentum; Poynting vector; Maxwell stress tensor. Plane waves, polarization. Reflection and refraction; diffraction. Relativity. Radiation from sources. Motion of charged particles in electromagnetic fields; magnetic mirrors, particle accelerators. Introduction to plasma physics; magnetohydrodynamics. Radiation from acceler-

ated charges; bremsstrahlung, synchrotron radiation. Scattering of radiation; interaction of radiation with matter. *Prep.: PHY 1403, PHY 3601 (concurrently).*

PHY 3621, PHY 3622, PHY 3623 Quantum

Theory A, B, C

4 Q.H.

Experimental basis of quantum theory. Schrodinger equation and probability interpretation of wave mechanics. Uncertainty principle. Application to one-dimensional problems, the harmonic oscillator, orbital angular momentum, and the central force problem. Quantum theory of scattering. Born approximation. Phase-shift analysis, introduction to S-matrix theory. General formulation of quantum mechanics in Hilbert space. Spin. Identical particles and symmetrization principle. Time-independent and time-dependent perturbation theory. Semiclassical theory of radiation and atomic spectra. Addition of angular momentum. Wigner-Eckart theorem. Quantum theory of radiation. Absorption, emission, and scattering of photons. *Prep.: PHY 1415 or equiv.*

PHY 3624 Advanced Quantum Theory

4 Q.H.

Introduction to the formulation of a relativistic quantum theory. Study of the Dirac equation and its Lorentz covariance. Plane-wave solution of the Dirac equation, and projection operators. Bound-state solutions of the Dirac equation in a Coulomb field and the hydrogen atom. Parity, charge conjugation, and time-reversal symmetries. Propagator theory. *Prep.: PHY 3623.*

PHY 3631 Statistical Physics A

3 Q.H.

The phenomenological theory of thermodynamics. Fundamental relations and thermodynamic potentials. Extremal principles of thermodynamics. Applications to simple systems. Stability conditions. Phase transitions. Thermodynamics of electric and magnetic systems. Principles of irreversible thermodynamics. *Prep.: PHY 3603 and PHY 3621 (concurrently).*

PHY 3632, PHY 3633 Statistical Physics B, C

3 Q.H.

The principles of statistical mechanics and statistical thermodynamics. Density matrix. Theory of ensembles. Derivation of the laws of thermodynamics. Fermi-Dirac and Bose-Einstein statistics. Application to gases, liquids, and solids. Theory of phase transitions. Second-quantization formalism for interacting systems. Cooperative phenomena. *Prep.: PHY 3631, PHY 3621.*

PHY 3641, PHY 3642 Solid State Physics

4 Q.H.

The course covers topics from Drude and Sommerfeld (or free electron) models of electrons in metals, crystal structure, one-electron states in crystal lattices, Bloch's Theorem, semiconductors and semi-conducting devices, effects of electron-electron interactions, lattice vibrations and the classical and quantum theories of specific heat,

optical properties of solids, investigation of crystal structure and excited states of crystals by X-ray and neutron scattering, simple transport theory based on the Boltzmann equation, magnetic properties of solids.

III. Advanced Electives

PHY 3643, PHY 3644, PHY 3645 Advanced Solid State physics A, B, C 4 Q.H.

Selected advanced topics in the theory of solids to be chosen each time by the interested students and instructor. For example, theory of normal metals, Hartree-Fock and Random phase approximations, optical and transport properties, solid-state plasmas, Raman spectroscopy, quasiparticles and collective excitations, quantum solids, amorphous solids. *Prep.: PHY 3633, PHY 3623, PHY 3642.*

PHY 3653, PHY 3654, PHY 3655 Particles, Fields, and Currents A, B, C 4 Q.H.

Introduction to a local field theory. Symmetries of the Lagrangian and conservation laws. Lorentz group, spin and helicity. P, C, and T. Klein-Gordon, Dirac, vector meson, photon and non-Abelian gauge fields. Gauge theories; Feynman path integral formulation. The S-matrix and LSZ reduction formulae. Spectral representations. Feynman diagrams. Green's functions at large Euclidean momenta. Renormalization and finiteness. Quantum chromodynamics. The renormalization group and asymptotic freedom. Spontaneous breaking and Higgs phenomenon. Glashow-Salam-Weinberg unified theory of weak and electromagnetic interactions. *Prep.: PHY 3624*

PHY 3661, PHY 3662, PHY 3663 Many-Body Theory A, B, C 4 Q.H.

Introduction to some many-body problems and the required mathematical techniques. Theory of linear response and correlation functions. Landau's theory of Fermi liquids and applications to solids. Theory of superconductivity and superfluidity. General theory of Green's functions and diagrammatic techniques. *Prep.: PHY 3633, PHY 3623, PHY 3642.*

PHY 3671 General Relativity 4 Q.H.

The course discusses the physical basis underlying relativity (the weak and strong principle of equivalence), the role of the metric tensor as a carrier of gravitational information, and the modification of the Lorentz covariant field equations in the presence of gravitation. An introduction to Riemannian geometry is given, and the Einstein field equations and tests of Einstein's theory are discussed. *Prep.: PHY 3672, PHY 3603, PHY 3613, and PHY 3623.*

PHY 3672 Relativistic Astrophysics 4 Q.H.

The course deals with the equations for the relativistic stellar system, white dwarfs, neutron stars and properties of pulsars, gravitational collapse and black holes, quantum radiation from black holes, super heavy stars as possible quasar energy sources, quantum effect in gravitational collapse, the metric for cosmological systems, and the big bang theory. *Prep.: PHY 3671 and PHY 3624.*

PHY 3673 Quantum Gravity 4 Q.H.

The course deals with gravitation as a quantum field, threshold properties of gravitational quantum S-matrix, quantization leading to a set of Feynman rules, calculations of simple tree diagrams, closed loop infinities and the problem of renormalizability of quantum gravity. *Prep.: PHY 3672*

PHY 3798 Master's Thesis Continuation 0 Q.H.

PHY 3799 Doctoral Dissertation Continuation 0 Q.H.

PHY 3811, PHY 3812, PHY 3813 Reading Course 1 Q.H.

PHY 3821, PHY 3822, PHY 3823 Reading Course 2 Q.H.

PHY 3831, PHY 3832, PHY 3833 Reading Course 3 Q.H.

PHY 3841, PHY 3842, PHY 3843 4 Q.H.

Reading course, or theoretical or experimental work under individual faculty supervision. *Prep.: Consent of faculty member.*

PHY 3895 Doctoral Dissertation

Experimental and theoretical work for Ph.D. candidates.

Political Science

All courses carry three quarter-hours of credit unless otherwise specified. Most courses are seminars.

ECN 3111 Economics for Public Administrators

Introduction to basic economic concepts essential to other courses in the program. This course is a prerequisite for students lacking economic course work at the baccalaureate level.

POL 3500 Scope and Methods of Political Science

This course is designed as an in-depth examination of the assumptions, principles, etc., that underlie contemporary political science. As such,

it invites the student to consider the present practice of the discipline in the light of its history and to critically evaluate the discipline in the interest of a greater understanding of nature and limits.

POL 3502 Seminar in American Government

Analysis in depth of selected problems in American government. Examples of problems include transition of American political parties, legislative reapportionments, and the decline of Congress as a law-making body. *M.P.A. elective.*

POL 3504 Political Psychology and Socialization

An examination of theories of political psychology, opinion formation, and attitude change; of political ideology; of processes of individual political development and socialization; of effects on mass and elite political behavior; of attitudinal differences and differential socialization experiences; of individual political behavior and the political system.

POL 3506 Politics and the Mass Media

Study of the role of mass media in the formation of public opinion, with special attention given to media usage in the electoral process.

POL 3508 Legislative Process

Study of Congress and of the influence of the President, administrative bureaucracy, parties, interest groups, and public opinion on the development of legislative policy. Comparisons are made with legislative process in the states. *M.P.A. elective.*

POL 3510 Theories of American Political Participation

This course focuses on political behavior at both the national electorate level and at the level of legislative roll-call voting, analyzing the relative impact of demographic and attitudinal components as well as the effect of constituency and partisan identification upon legislative behavior.

POL 3512 American Constitutional Law I

Employing excerpts of U.S. Supreme Court decisions and other primary legal materials, this course examines the constitutional rationale for judicial review; various philosophical approaches to the exercise of judicial power; and the scope of judicial authority to settle questions challenging the legitimacy of governmental actions in the American constitutional system.

POL 3514 American Constitutional Law II

Using excerpts of primary legal materials, this course builds upon the judicial doctrines developed in POL 3512 and specifically examines the constitutional theories behind the growth of congressional prerogatives in economic and social affairs and expanding presidential power in internal and foreign matters. *Prep.: POL 3512 or consent of the instructor.*

POL 3516 The Presidency

An analytic treatment of the constitutional and extraconstitutional powers of the contemporary

president, an examination of the place and function of the chief executive in the formulation and execution of public policy. *M.P.A. elective.*

POL 3518 American Electoral Behavior

The theoretical and methodological assumptions of election studies of the American political system are analyzed and the substantive conclusions carefully reviewed.

POL 3519 Campaigns and Elections

A study of campaign tactics and strategies. *Field Work required.*

POL 3520 The Judiciary

Analysis of the role of the judiciary in the American governmental process. Special attention is given to those areas of constitutional law in which the courts' decisions have a profound impact on the basic structure of American politics (apportionment, economic regulation, federalism, etc.).

POL 3522 Political Parties, Pressure Groups, and Public Policy

A study of the role of parties and pressure groups in the policy-making process, trends in contemporary party politics are examined as well as behavior patterns of the American electorate.

POL 3524 Civil Rights

Examination of the doctrine of constitutionalism, illustrated and amplified by a study of the substance and process of the Bill of Rights as developed in decisions of federal courts, and congressional enactments.

POL 3526 Procedural Due Process

Utilizing excerpts from U.S. Supreme Court decisions and other legal materials, this course examines the philosophical and constitutional relationships between Amendments 4, 5, 6, and 8 and the Fourteenth Amendment. The substance of the right to fair trial, counsel, confrontation, protection against self-incrimination, and unreasonable searches and seizures are among the many procedural rights examined through the decisions of the Roosevelt, Vinson, Warren, and Burger Courts.

POL 3531 Models of Political Systems

A detailed examination and critique of current models of political systems.

POL 3533 Eurocommunism

A study of the ideology and political behavior of the communist parties of Italy, France, and Spain, with emphasis on their independence of, and challenges to, the domestic and foreign policies of the Soviet Communist Party.

POL 3535 Parliamentary Democracy in Western Europe

A comparative analysis of environment, vehicles of popular participation, and formal structures and reach of government in the parliamentary democracies of western Europe. Special attention is given to England, France and Germany.

POL 3537 Comparative Communism

A comparative analysis of environment, vehicles of popular participation, and formal structures and reach of government in the Soviet Union, the socialist countries of eastern Europe, and China.

POL 3539 European Political Parties

A comparative cross-national study of political organization and behavior in England, France, and Germany with emphasis on party leadership, strategy, organization, and constituency as well as socialization, recruitment, and participation of voters.

POL 3541 European Legislative Systems

A comparative analysis of the legislatures in Britain, France, and Germany with emphasis on patterns of historical development, functions, internal organizations, and relations with the executive.

POL 3543 European National Executives

A comparative cross-national study of executive decision making in England, France, and Germany with emphasis on varying patterns of presidential and cabinet authority as well as relationships with the legislature.

POL 3545 Government and Politics in the Middle East

This course examines the political and economic structures of the Arab states and Israel as well as inter-Arab politics and inter-state conflict in the area.

POL 3547 Government and Politics of North Africa and the Middle East

Comparative analysis of the political systems and foreign policies of African states north of the Sahara. Also stressed is the relationship of this area with the Middle East.

POL 3550 Government and Politics of the United Kingdom of Great Britain and Northern Ireland

An analysis of government organization and political behavior in the United Kingdom. Special attention is given to executive-legislative relations, the political party system, and the politics of Northern Ireland.

POL 3551 Seminar in International Relations

An in-depth analysis of the major actors, their goals, and the means and strategies they utilize within the international system.

POL 3552 International Political Economy

The course explores new directions in the field of international political economy. Stress is laid on approaches to and trends within the field, such as 1) the intellectual and theoretical roots of international political economy; 2) the management of collective goods; 3) relations between advanced industrial states; 4) relations between advanced industrial and less industrial states; 5) relations between nonstate and state actors.

POL 3553 Government and Politics in Germany

A study of political culture, federalism, and executive-legislative relations on the national level with a view to appraising the quality and durability of the present democratic system.

POL 3554 Government and Politics of France

A study of current governmental organization and political behavior in France. Special attention is given to the role of the presidency, executive-legislative relations, and the political party system.

POL 3555 International Organization

This course focuses on issues of international political economy. The role of various international organizations in managing economic interdependence is emphasized. Attention is given also to the role of international administrators in the UN's search for a new international economic order. Discussion of nongovernmental organizations, such as multinational corporations, is included.

POL 3556 China in Revolution

Addresses the problems faced by a revolutionary China in forming new attitudes, instituting a revolutionary political culture, and reconstructing and developing a country on the basis of a revolutionary ideology. Illustration of the manner in which the party, state, military, education, health, science, and medicine have been modified since 1949 to ensure the continuation of a revolutionary polity.

POL 3557 Soviet-Chinese Relations

A chronological and topical analysis of the Soviet-Chinese relationship since 1950 with special attention to the causes of rivalry and conflict in the 1960s and 1970s.

POL 3558 Asia and the Politics of Development

This course relates the theoretical literature on political development to the concrete attempts to develop in Asia. Because of the diversity in levels and types of political development in Asian states, each student is encouraged to concentrate on one state and explore different ideas about political development as they relate to that state.

POL 3559 Governments and Politics of Latin America

This course investigates contemporary Latin American politics with particular emphasis on revolution, development strategies, and social change. Focus is on three representative nations such as Mexico, Chile, and Cuba.

POL 3560 Development Politics

The process of political development in the Third World, including both internal and international issues such as leadership patterns, the role of the military and political parties, and underlying economic and social factors.

POL 3561 Great Powers and the Middle East

An analysis of the changing nature of great power and multinational involvement in the Middle East.

POL 3562 United States-Soviet Relations

The relations between the United States and the Soviet Union from 1917 to the present. Topics stressed are the "nonrecognition" period, the breakdown of the World War II "Grand Alliance," and the nature of the present power conflict.

POL 3563 United States-Far Eastern Relations

American diplomacy in the Far East, with primary concentration on relations with Japan since World War II, with China, and with Southeast Asia.

POL 3564 China's Foreign Policy

A study of the Chinese government's relations with the Third World socialist states and the West and its behavior in the United Nations. Analyzes changing policies toward international law, trade, tourism, scholarly exchange, and foreign ventures in China. Attention is given to policy objectives strategy, tactics, and the method of decision making in the foreign policy apparatus.

POL 3565 Soviet Relations with Eastern Europe

An analysis of Soviet policy in Eastern Europe, especially Russian efforts after World War II to develop communism and maintain a position of preeminence in this region.

POL 3566 Chinese Politics

Concentrates on the objectives of the Chinese revolution from 1911 to the present. Examines the political theory and institutions which have been established to promote "permanent revolution" and evaluates the nationality of Chinese communist policies in terms of Chinese goals. Concentrates on the changes made in domestic, economic, legal, and political policies since 1976.

POL 3567 Japanese Politics

Designed for students in both comparative politics and in international relations, the course examines the unique Japanese electoral system, political processes and organizations, political culture and socialization, the role of business in politics, and Japanese foreign policy.

POL 3568 Sub-Saharan African Politics

Comparative analysis of the political systems and foreign policies of selected African states south of the Sahara. Special attention is given to the Republic of South Africa and its policy of apartheid.

POL 3569 Decision Making in U.S. Foreign Policy

Comprehensive analysis of the governmental mechanism and process for decision making in U.S. foreign policy. Case studies in decision making are emphasized.

POL 3570 American Foreign Policy

Examination in depth of selected issues concerning the role of the United States in world affairs since 1945.

POL 3572 Problems of World Order I

Emphasizes such topics as appraisal of diverse systems of public order, approaches of interna-

tional law and international organization to the problem of world order, and the problem of world peace enforcement.

POL 3573 Problems of World Order II

Political problems of world order are stressed. Representative topics include arms control and disarmament, the limits of economic growth, international political economy, population problems, and resource distribution.

POL 3575 Arab-Israeli Dispute

The Arab-Israeli confrontation has its own dynamics and a character that has changed through the decades. This course analyzes its interaction with the internal politics of the Arab states and Israel, pan-Arab politics, and the role of the great powers in the region.

POL 3578 Soviet Foreign Policy

A study of Soviet foreign policy since 1964. Among the topics discussed are detente in relations with the United States; polycentrism in East Europe; involvements and commitments in the Middle East and Africa; and the dispute with China.

POL 3580 The United Nations

Selected topics on the nonpolitical work of the United Nations: human rights; economic, social, health and related problems; decolonization and the trusteeship system.

POL 3581 International Peacekeeping

A detailed investigation of the origins, history, and theory of interventionary peacekeeping, with reference to the documentation of the United Nations. An assessment of this method of maintaining regional stability and a projection of potential means of developing the method to broader applicability.

POL 3583 International Law

Examination of selected topics in international law not covered in POL 3572 and POL 3573.

POL 3584 Regional Organizations

Regional organizations, such as EEC or OAU, are studied to determine the capability of such organizations to promote economic development and political influence.

POL 3585 The Atlantic Community

A topical analysis of European-American diplomacy with particular stress upon security and economic matters. Major consideration of the integration of Europe, American responses, and the results of these interactions for world political and economic stability.

POL 3586 Nationalism

The evolution and role of nationalism in both theory and practice. Representative nationalistic movements and theories are analyzed.

POL 3587 Politics of Revolution and Change

Analysis of the nature of political change with attention to both theory and practice. Topics discussed are revolution, major trends in contempo-

rary politics, and the relationship between political change and technological, scientific, or social change.

POL 3589 Terrorism, Violence and Politics

Analysis of the theory and practice of terror, violence, coercion, force, and threats in political life.

POL 3590 Crisis Politics In Democracies and Dictatorships

Analysis of governmental response to crises and emergencies. Consideration of such topics as war powers, riot and rebellions, martial law, transfer of regime, succession problems, economic crises, presidential emergency powers, national security powers, executive privilege, and impeachment.

POL 3591 Totalitarianism

An analysis of totalitarianism and dictatorship, including study of historical background, fundamental characteristics; theories of origin, nature, and significance; and evaluation of techniques, ideologies, policies, and instruments of power. Special attention is given to the government and politics of the Soviet Union.

POL 3593 Ancient and Medieval Political Thought

The development of political thought from Greek antiquity to the end of the Middle Ages, utilizing both historical and analytical approaches. Attention is also paid to the cultural, social, and intellectual context within which political theories develop.

POL 3594 Modern Political Thought

Examination of political thought from Machiavelli to Marx.

POL 3595 Contemporary Political Theory

The main currents of political thought in the latter half of the nineteenth and the twentieth centuries with special emphasis on the relations between political theory philosophy and political science.

POL 3596 Marxism

Examination of the theory and practice of Marxism, including its background and origins, and its subsequent development.

POL 3597 Trends in American Political Thought

Examination of intellectual concepts and movements that have informed and influenced American political life, with emphasis upon those relating to the making and execution of public policy. *M.P.A. elective.*

POL 3600 Survey of Public Administration

Introduction to the literature and the major topics in public administration with special attention given to the interrelationships of politics and administration. *M.P.A. core course.*

POL 3601 Public Personnel Administration

Technique, practice, and organization of personnel functions in public administration, including recruitment, compensation, training, discipline, and relations with employee organizations. *M.P.A. core course.*

POL 3602 Organization Theory and Management

An in-depth study of the major organization theories, including the scientific basis for organization theory; models and ideal types; decision making; application of game theory, systems analysis. *M.P.A. core course.*

POL 3603 Public Finance and Budgeting

Emphasizes the public budgeting function in its relationship to other functions of public administration. The subject is approached from a management perspective, and conflicting legislative and executive finance and budgeting interests are examined. Also included is an illustration of the budget cycle and an examination of the mechanics of budget preparation. Attention is given to means for improving budget decision making and administration through quantitative and other methods. *M.P.A. core course.*

POL 3604 Techniques of Policy Analysis

Focuses on the various techniques useful in analyzing public policy issues. Case studies of specific applications of such methods as modeling, simulation, and survey research are examined. *M.P.A. elective.*

POL 3605 Quantitative Techniques for Public Administrators I

A consideration of the theory and process of administrative study including philosophy of science, quantitative and qualitative designs and methods of problem solving, and drawing causal principles. *M.P.A. core course.*

POL 3606 Quantitative Techniques for Public Administrators II

The application of social science research and computer programming to administrative problems, including techniques for analysis of survey and other data and practical methods of gathering, analyzing, and presenting such data. *M.P.A. core course.*

POL 3607 Quantitative Techniques III: Computer Applications

A continuation of the study of quantitative techniques, with particular emphasis on various computer usages for public managers.

POL 3610 Methods of Economic Analysis for Public Administrators

A central concern of this course is to introduce a construct of public economy as a means for focusing on contemporary issues facing public administrators. Both the concepts and applications of economic analysis are presented to offer the student a new analytical tool for evaluating public policy, implementation, and impacts on the citizenry. *M.P.A. elective.*

POL 3611 Intergovernmental Relations

An institutional-behavioral analysis of the changing relationship among the various levels of American government—national, state, and local—re-

lating the pattern of change to the social and economic forces which underlie it. *M.P.A. elective.*

POL 3613 Constitutional Law in Public Administration

An introduction to American constitutional law and the federal system using case materials and emphasizing principles of importance to public administrators, including such constitutional concepts as separation of powers, judicial review, dual federalism, legislative investigating power, executive impoundment, federal preemption, and the appointment and removal power. *M.P.A. elective.*

POL 3614 Administrative Ethics in Public Management

An analysis of ethical problems in American public administration including discussion of ethical dilemmas frequently faced by public managers. *M.P.A. elective.*

POL 3615 Development Administration

This course will focus on the output side of developmental administration from a management viewpoint. Particular emphasis will be placed upon implementation, evaluation, and project management skills, including management of public enterprises. While technically oriented, the course will deal also with practical problems of management in Third World systems such as strategies for the utilization of talent within the local community, etc.

POL 3616 State Government

Appraisal of the problems of contemporary state government in the United States. Particular emphasis is given to the state government of Massachusetts. Individual research is stressed. *M.P.A. elective.*

POL 3618 Problems in Urban Planning

An exploration of the resources available to the urban planner for policy implementation, including zoning, subdivision regular action, and capita improvement programs. Special emphasis is given to the planning of individual sites. *M.P.A. elective.*

POL 3619 Techniques of Urban Planning

A study of the history and techniques of city planning, stressing the elements of planning. *M.P.A. elective.*

POL 3620 Politics of State and Urban Planning

An investigation of the relationships of planning to other governmental functions with stress on practical processes, particularly at the municipal government level. *M.P.A. elective.*

POL 3621 Problems of Urban Development

An examination of the role of government and politics in the planning, programming, and administration of regional and urban development in the United States. Consideration is given to urban renewal; interurban and interregional competition; interstate compacts; public authorities; T.V.A.,

Appalachia, and New England regional development; antipoverty programs; and conflict between public and private interests. Individual research is stressed. *M.P.A. elective.*

POL 3622 Urban Government

The contemporary crisis in urban government—problems of political independence, government finance and administration, rapid growth of sub-urban and metropolitan areas, and decline and decay of the core city are stressed. Particular emphasis is given to the Boston metropolitan area. Individual research is stressed. *M.P.A. elective.*

POL 3623 Transportation Policy

Examination of the role of politics, governmental mechanisms, and public policy in the transportation planning process. Particular attention is given to political interest groups and the manner in which they affect transportation policy on the federal, state, and local levels. *M.P.A. elective.*

POL 3624 Problems of Community Development

Examination of the role of government, politics, and public policy in the urban process and related problems in the United States. *M.P.A. elective.*

POL 3625 Collective Bargaining in the Public Sector.

Study of the mechanism for labor relations in federal, state, and local government with its impact on the public manager. Emphasis is placed upon collective bargaining processes, tactics, and techniques. *M.P.A. elective*

POL 3626 Grantsmanship

This course provides students the opportunity to increase their knowledge of the federal grant system. Emphasis is placed on developing the ability to write effective grant proposals and on improving management skills.

POL 3627 Management Information Systems

The course studies the life cycle of a management system through its three phases: (1) study and design; (2) implementation; and (3) operation within the target organization. Focus is on exploring the impact which management information systems have and may have in the future on governmental managers, on their professional environment, and on the society which they serve. Various government MIS will be studied. The course requires no mathematical or data-processing background. *M.P.A. elective.*

POL 3629 Computers and Public Administration

A general orientation to the computer, its uses and operation, with particular attention to programming analysis, preparation and coding, and use of computer programs specifically written for governmental applications. *M.P.A. elective.*

POL 3630 Health-Care Administration

An examination of the politics and administration of health-services delivery systems, including a discussion of current topics in health-care admin-

istration and politics (e.g. national health insurance, health-maintenance organizations, physician assistants, citizen participation, administration decentralization) and an introduction to current developments in policy evaluation methodology and health-services research. *M.P.A. elective.*

POL 3631 Housing and Community Development

An introduction to exploration of two major urban social policy issues in terms of their political, economic, and social dimensions. Specific programs and issues in the metropolitan and New England region are evaluated. *M.P.A. elective.*

POL 3632 Public Fiscal Management

A study of the interrelationships in public administration between systems of finance and the achievement of program objectives. Emphasis is placed upon those aspects of the budgetary process that bear on fiscal policy and appropriations. *M.P.A. core course.*

POL 3634 Functions and Techniques of Public Management

An introduction to problems in public management and techniques for dealing with them including functions of middle management, supervision, administration of staff activities (e.g. planning, personnel, budget), organization and methods, public relations, managerial use of computer-based techniques, and tactics and strategies of management. *M.P.A. elective.*

POL 3635 Environment and Energy Policy

Consideration of the legal, political, administrative, and intergovernmental factors involved in the formulation of public policy and the exercise of public power in regulating the use of the environment. Individual research is stressed. *M.P.A. elective.*

POL 3637 Comparative Public Administration

A comparative study of approaches to public administration in selected democratic governments in the United States and Europe. *M.P.A. elective.*

POL 3639 Federal Administrative Law

Study of rule making, adjudication (formal and informal), administrative finality and judicial review, administrative procedure, scope of administrative powers, and enforcement techniques. *M.P.A. elective.*

POL 3640 Governmental Accounting

Examination of principles and procedures involved in governmental accounting. *M.P.A. elective.*

POL 3641 Techniques of Program Evaluation

A review of the various methods used to assess public policy including identification and categorization of outcome, input and program operation variables; types of research designs; and steps

needed to institute program change after completion of an evaluation study. *M.P.A. elective.*

POL 3642 Management Planning and Decision Making

A review of the growth of the planning approach to public management and of its application in specific agencies. Topics include organization of the management planning function, budget planning, and methods of providing planning forecasts. *M.P.A. elective.*

POL 3643 Organizational Psychology and Behavior

Examination of the literature, theories, and concepts of administrative behavior as it has evolved with emphasis on the development of self-awareness and the building of interpersonal skills. *M.P.A. elective.*

POL 3644 Public Policy Issues in Human Services

Discussion of the origins and development of the Social Security Public Assistance Income Maintenance and various health-care programs. The course content focuses on controversial public policy issues of retirement, survivors, disability insurance, Aid to Families with Dependent Children, Medicare, and Medicaid, with the objective of helping students to develop understanding of the push and pull of many different viewpoints involved in public policy development. *M.P.A. elective.*

POL 3645 Program Implementation

This course examines the implementation stage of the policy process, specifically the implementation of federally funded social programs by local governments. Topics include: intergovernmental fiscal configuration; the capacity to implement; the politics of implementation; implementation feasibility.

POL 3646 Position Management

An examination of the bases of position classification at the state, federal, and local levels. After reviewing the process of job analysis, the course examines several classification schemes including the new federal factor benchmark system. Final topics include wage and salary administration. *M.P.A. elective.*

POL 3647 Manpower Policy and Administration

Introduces the student to human resource policy and management issues within a broader context of social policy. Includes an investigation of specific manpower programs and current issues of importance to the administrator. *M.P.A. elective.*

POL 3649 Regulatory Administration

This seminar is designed to offer the public manager a conceptual and historical overview of the development of regulatory policy and mechanisms, focusing on issues at the public-private interface as well as evaluating the practical implica-

tions of government intervention. Also included is an evaluation of the political, economic, and administrative effects of a nonregulatory vs. regulatory approach to public management. *M.P.A. elective.*

POL 3650 Group Dynamics

Based upon an introductory understanding of organizational psychology and behavior, this seminar focuses on the human problems public managers face in their daily work. Using a group dynamics format, each participant will have the opportunity to integrate the literature in organizational psychology, work issues, and personal growth concerns. *M.P.A. elective.*

POL 3652 Civil Liberties in Public Administration

Discussion of First Amendment rights as they impact upon the public sector. Referring to appropriate court cases, topics include employee rights and obligations with respect to freedom of speech, freedom of association, loyalty oaths, and professional certification, as well as legislative powers. *M.P.A. elective.*

POL 3653 Survey Research for Public Administration

Focuses on the entire survey research process from ample selection to data analysis. Regression for time series analysis and some computer applications are discussed. *Prereq. POL 3605*

POL 3654 Computer Software for Public Administrators

This course will be offered as an elective at least once per year. The course will provide an introduction to several software packages for: statistics; management file construction and use, word processing, and graphics. *Prereq. POL 3605.*

POL 3655 Politics and Administration in Cities and Towns

An examination of the political and administrative structures which influence the conduct of city and town governments. Particular attention is given to the dynamic relationships between these structures and the implications for public policy-making. *M.P.A. elective.*

POL 3657 Organizational Analysis

A study of the structure and processes of organization essential for problem solving and for effecting organizational change. Emphasis is placed upon the application of social science theory and administrative principles in administrative problem identification and problem resolution. *M.P.A. elective.*

POL 3658 State and Local Finance and Budgeting

This course explores the many channels that the state budget must travel before it becomes a viable document. The several ways by which the budget can be affected before and after it is signed into law are explored in depth. *M.P.A. elective.*

POL 3659 Municipal Finance

A discussion of the special problems of budgeting and finance in local governments, including budget preparation and presentation, debt management, capital financing, and local taxation policy. *M.P.A. elective.*

POL 3660 Development Planning

This course will focus on the major techniques of analysis and planning in key problem areas of developing nations. Emphasis will be placed on the technical skills necessary to analyze and plan in major problem areas such as land use, population control, transportation, education, urban services, health services, etc. *Prereq.: POL 3604, 3605, 3606.*

POL 3661 Municipal Law

Designed for the nonlawyer, this course reviews the law of municipal corporations. Topics include general powers and duties, charters, ordinances, administrative rules and regulations, officers and employees, tort liability, policy powers, planning and zoning, taxation and borrowing, elections, and licenses and permits. *M.P.A. elective.*

POL 3662 Comparative Urban Government and Administration

This course analyzes decision-making structures and processes in selected urban areas, including an examination of world organization trends and implications for administration and politics of cities; changing scopes, scale, participants, and organization of urban politics; and selected issues such as urban housing, finance, leadership, planning and goals. *M.P.A. elective.*

POL 3663 Techniques of Public Budgeting

Introduction to the practical skills necessary for the formulation, evaluation, and presentation of budget data. Budgetary information (raw data) provided from computer simulations and from state and local governments is analyzed and adapted to various types of budget formats. *M.P.A. elective.*

POL 3664 Politics and Issues in Public Budgeting

The study of public budgeting in the context of the political, financial, and economic environment of present-day government. A heavy focus on contemporary issues and events which affect budgetary processes in the public sector is included. *M.P.A. elective.*

POL 3665 Women in Public Management

Analysis of the multiple roots of problems experienced by women in public management positions and solutions for alleviating such problems. Students are expected to engage in experiential learning exercises in addition to academic work. *M.P.A. elective.*

POL 3666 Housing Crisis

This course surveys the housing problems associated with the poor, the elderly, and middle-class

citizens. It studies housing policies which have been enacted on the national and local levels and assesses the impact of these policies.

POL 3667 Equal Opportunity in Public Administration

This course is designed to (1) examine barriers to EEO, (2) help students develop an awareness of issues surrounding the Affirmative Action Program and particularly some of the historical perspectives of discrimination against minorities and women; and (3) offer instruction in techniques for developing a meaningful equal opportunity program for public organizations. *M.P.A. elective.*

POL 3668 Legal Issues in Public Personnel Administration

A review and discussion of fact situations and evidence which give rise to public employment litigation with emphasis on civil rights and Equal Employment Opportunities court actions. Class discussion includes the type of evidence used in litigation and the types of defenses available to public employers. *M.P.A. elective.*

POL 3669 Labor Relations in Public Administration

Examination of various theoretical models for analyzing labor-relations structures and dynamics as well as their historical development in the United States. Where appropriate, attention is given to private sector patterns for comparative analysis. Among the topics treated are bargaining unit determinations, management rights and the scope of bargaining, coalition bargaining, impasse-procedure options, contract administration, affirmative action, civil-service traditions, and public sector unions. *M.P.A. elective.*

POL 3670 Public Relations in Public Administration

Focuses on evaluating the public manager's role in the process of communication with the public. Issues of imagery and accountability as well as current topics are evaluated. *M.P.A. elective.*

POL 3671 Social Welfare Policy and Administration

The historical, political, social, and economic determinants of the U.S. social welfare system are examined. Present policies and programs are analyzed using a dynamic systems model. Practical experience from all levels of government is included. *M.P.A. elective.*

POL 3673 Career Development

Designed to help students make career choices, identify their own career stages, and better understand their role as part of a work organization, with the purpose of assisting students in career planning. *M.P.A. elective.*

POL 3674 Federal, State and Local Financial Relations

As state supervision of and assistance to local governments in the area of financial administra-

tion is becoming increasingly important, this course explores the relationships between the two levels of government in the assessment and collection of taxes, budgeting, debt management, and state aid. In addition, the federal role and fiscal intergovernmental relations are evaluated. *M.P.A. elective.*

POL 3675 Health Policy and Politics

An analysis of health care policies, procedures, and alternatives.

POL 3676 Practices in Self-Development in Public Management

This course focuses upon practical aspects of public management. Topics include time management, communication (e.g., memorandum and report writing), control processes, and conflict management.

POL 3677 Elder Services Policy and Administration

This course investigates the historical, socioeconomic and philosophical determinants of the emerging elder services system. Present policies and programs are studied using various comparisons, case studies, and dynamic models. Focus on contemporary problems in the administration of elder care delivery systems, funding sources, and future trends.

POL 3678 Federal Bureaucracy

Examination of dynamic and structural aspects of the national government, with attention to the place of the national administration in the federal system. *M.P.A. elective.*

POL 3679 Seminar in Development Administration

This course, undertaken after students complete the core as well as required concentration courses, will allow the student to deal with one or more problem areas in his or her country. Employing the skills developed in the Development Planning and Development Administration courses, students will develop plans and implementation strategies for a selected area(s) in their own nation, taking into account political, social, economic, and cultural realities. *Prereq.: All other concentration requirements.*

POL 3690 Topical Seminar

The program occasionally offers a special seminar dealing with current important issues relevant to public administration.

POL 3695 Seminar in Public Organization and Management

Analysis of specified topics and issues in public organization and management, with the purpose of presenting material of current interest and allowing in-depth research into specified areas where appropriate. Subject matter to be covered is described in registration materials. *M.P.A. elective.*

POL 3696 Seminar in Public Finance and Budgeting

Analysis of specified topics and issues in public finance and budgeting with the purpose of presenting material of current interest and allowing in-depth research into specified areas where appropriate. Subject matter to be covered is described in registration materials. *M.P.A. elective.*

POL 3697 Seminar in Public Personnel Administration

Analysis of specified topics and issues in public personnel administration with the purpose of presenting material of current interest and allowing in-depth research into specified areas where appropriate. Subject matter to be covered is described in registration materials. *M.P.A. elective.*

POL 3698 Seminar in Policy Sciences

Analysis of specified topics and issues in the policy sciences with the purpose of presenting material of current interest and allowing in-depth research into specified areas. Subject matter to be

covered is described in registration materials. *M.P.A. elective.*

POL 3699 Seminar in State and Urban Administration

Analysis of specified topics and issues in state and urban administration with the purpose of presenting material of current interest and allowing in-depth research into specified areas where appropriate. Subject matter to be covered is described in registration materials. *M.P.A. elective.*

POL 3798 Master's Thesis Continuation**POL 3890 Assigned Reading**

maximum: 6 Q.H.; minimum: 1 Q.H.

Assigned reading under supervision of a faculty member.

POL 3892 Internship Readings and Analysis

Academic credit directly related to an internship assignment.

POL 3895 Thesis

6 Q.H.

Thesis supervision by individual members of the department.

Psychology

All courses carry three quarter-hours of credit unless otherwise specified.

PSY 3111, PSY 3211, PSY 3311 Quantitative Methods I, II, III

A survey of the quantitative methods used in experimental psychology, emphasizing applications of computer programming, theory of functions and relations, curve fitting, probability functions, set theory, and analysis of variance.

PSY 3113, PSY 3116, PSY 3118, PSY 3115 Proseminar I, II, III, IV 4 Q.H.

The departmental proseminar faculty lectures, student presentations, and discussions of the experimental literature in the following areas: learning, motivation, and behavioral analysis; sensation and perception; neuropsychology, language and cognition.

PSY 3119, 3219, 3319 Attention I, II, III

Seminars dealing with the topic of attention (selective and general, e.g., arousal, attentiveness, etc.). Behavioral, cognitive and physiological aspects will be discussed.

Learning and Behavioral Analysis**PSY 3121 Experimental Design in Applied Research**

Detailed study of experimental methods, emphasizing critical analysis of published research reports and the implementation of the methods in service settings. Students have the opportunity to learn and evaluate observational measurement and data-collection techniques. A feasible ex-

perimental design, with graphed actual or hypothetical data, must be written in the form of a scientific report.

PSY 3122, PSY 3222, PSY 3322, PSY 3422, PSY 3522 Applied Programming Seminar I, II, III, IV, V

Students are expected to design, test, and evaluate instructional programs for teaching specific subject matter for remedial application to behavior problems and to test instructional theory. Supervision is provided by a weekly programming research and data seminar in collaboration with the student's adviser.

PSY 3123 Programmed Learning

A review of the history and theoretical and experimental bases of programmed instruction and errorless learning. Emphasis is placed on the detailed analysis of stimulus control—its measurement, and ways to produce it.

PSY 3129 Mental Retardation Seminar

Interdisciplinary seminar taught by faculty from the several Boston-area universities associated with the University-affiliated facility. The role of each discipline in the care and treatment of retarded people is defined and coordinated with the functions of other relevant disciplines. Specialties include communication disorders (Emerson College), dentistry (Tufts University), medical disciplines (e.g., pediatrics, neurology, orthopedics, genetics—Massachusetts General Hospital, Har-

vard Medical School), nursing (Boston University), nutrition (Framingham Teacher's College), occupational therapy and physical therapy (Sargent College of Boston University), social work (Boston University and Simmons College), sociology (Brandeis University), special education (Boston University), and psychology (Northeastern University).

PSY 3132, PSY 3232 Behavior Intervention I, II

Students are given instruction in behavioral intervention techniques. Emphasis is placed on the functional analysis of behavior.

PSY 3133, PSY 3233, PSY 3333 Advanced Learning Seminars I, II, III

These seminars cover contemporary research in operant conditioning, with emphasis on relating the techniques of behavioral analysis to problems of reinforcement, motivation, comparative psychophysics, and physiological psychology.

PSY 3143, PSY 3243 Learning Principles and Applications I and II **4 Q.H.**

An analysis of principles from behavioral learning research and their application to the process of behavior change for learning, remediation, and treatment. Particular emphasis is on educational settings.

PSY 3229 Administration of Mental Retardation Services

Presents comprehensive overview of general and specialized services for retarded individuals from organizational and administrative points of view. Issues in planning and initiating new programs, service delivery, staffing, and economics are covered. Visits to varied types of facilities focus on administrative concerns.

PSY 3321, PSY 3421, Systematic Inquiry in Applied Research I, II

Each student is expected to collect a comprehensive bibliography on a significant topic in applied behavior research and complete a thorough review via written and oral presentations. Emphasis is placed on the integration and analysis of experimental findings and theoretical foundations of the research area, the critical evaluation of current research, and the definition of potentially fruitful future work.

PSY 3649 Community Based Treatment **3 Q.H.** (Prereq.: Permission)

The treatment of mentally retarded individuals in a community setting.

PSY 3324 Behavior Change in Institutions

A review of successful projects which have been carried out to provide effective remediation and rehabilitation in institutions for the mentally retarded, the juvenile delinquent, and the developing individual (schools).

Sensation and Perception

PSY 3185 Electrophysiological Recording

Methods for recording electrophysiological activity from the human subject including electroencephalography, auditory and visual-evoked potential recording, electroretinography. Consideration of some of the principal findings that have been obtained with these methods and their importance for the interpretation of a variety of psychological phenomena.

PSY 3188, PSY 3288, PSY 3388 Vision I, II, III

Seminars: classical and modern problems in vision. Recent journal articles provide primary source materials for discussion. Consideration is given to problems of stimulus specification, retinal structure, photochemistry, and psychophysical measures of sensitivity, color vision, and electrophysiology.

PSY 3189 Psychoacoustics

This seminar deals with the relationship between sound and auditory perception. After five tutorial sessions on the physics and laboratory generation of sound, thresholds, masking, loudness, pitch, and sound localization, students are expected to lead discussions based on research papers in the psychoacoustic literature.

PSY 3289 Perception

A detailed consideration of research in such areas as form, space, and pattern perception, recognition, and the effects of set and motivation on perception. Physiological concomitants of perceptual phenomena are considered.

PSY 3418 Modern Psychophysics

A mathematical study of signal-detection theory; human and animal psychophysical methods; theory of the ideal observer.

Neuropsychology

PSY 3127, PSY 3128 Neurological and Sensory Impairments Seminars I, II

Etiology, assessment, and diagnosis, clinical characteristics, and education of the mentally retarded with visual, hearing, and motor deficits are studied. In addition to discussion, experiences are provided in evaluation and remedial programming, via the application of operant techniques.

PSY 3145 Human Neuropsychology 1 **3 Q.H.**

This course in neuroscience addresses brain function and structure. Specific disorders seen in the clinical population are related to disfunction of the nervous system.

PSY 3151 Brain and Behavior I

An introduction to basic methods of physiological psychology, including animal surgery, electrical stimulation of the brain, electrophysiological recording, and histological techniques. Students

have the opportunity to gain experience in these methods by carrying out a limited research project during the semester. Enrollment limited to ten. *Prep.: Admission to doctoral candidacy or permission of instructor.*

PSY 3155, PSY 3255 Sensory Psychophysiology I, II

Concentration on the anatomy and physiology of the various sensory systems and correlation of these data with psychophysical and perceptual concepts. Laboratory work is included.

PSY 3159 Neurochemistry and Behavior

This seminar examines different experimental approaches to the problems involved in uncovering the relationships between changes in brain activity and changes in behavior produced by drugs. Discussions center on current theorizing on the role of early experience, environmental factors, biological rhythms, and other facets in the determination of drug-induced behavioral changes.

PSY 3225 Biological Bases of Mental Retardation

The course considers the relationship between biological malfunction, of the brain in particular, and the defective learning ability and other behavioral abnormalities which constitute mental retardation. The aim is toward as comprehensive a survey as time permits. Exercises include actual case presentations as illustrative examples.

PSY 3251 Brain and Behavior II

Selected topics in the neurophysiology of perception, emotion, motivation, learning, and memory will be pursued in depth, with emphasis upon a critical evaluation of recent literature. Enrollment limited to fifteen. *Prep.: Admission to doctoral candidacy or permission of instructor.*

PSY 3355, PSY 3455, PSY 3555 Physiological and Comparative Psychology I, II, III

Seminars: a shared background, key concepts, and central issues in the field of physiological and comparative psychology.

Language and Cognition

PSY 3126 Child Language Development

Learning theory approaches to language acquisition are contrasted with psycholinguistic and neurogenic theories. Works of Skinner and Chomsky are analyzed, and implications for both normal and abnormal language development are discussed.

PSY 3161, PSY 3261 Cognition and Psycholinguistics I, II

Research in cognition and psycholinguistics.

PSY 3166 Psycholinguistics

Seminar. In-depth analysis of research methods and findings in selected problems in the psycholo-

gy of language, including developmental, anthropological, and experimental psycholinguistics.

PSY 3169 Seminar in the Structure of American Sign Language

This seminar is designed to introduce students to current issues in linguistic theory as well as to update them on the specific literature on ASL research. Focus is upon one particular area of linguistic theory as it relates to current ASL research, e.g., phonology, morphology, syntax, semantics, or discourse (varies from year to year).

PSY 3264 Language Acquisition 3 Q.H.

An overview of issues in language acquisition will be integrated with in-depth discussions of selected topics.

PSY 3269 Linguistic Theory and ASL: Special Topics 3 Q.H.

(Prereq.: Introduction to ASL Linguistics or Introduction to Linguistics)

This seminar will vary year to year. Each year we will focus upon a particular body of literature related to current linguistic theory and its relevance to ASL. The course will involve extensive reading of current articles and dissertations in linguistics in general and in ASL Linguistics. Students will be expected to do presentations during the course of the seminar.

Experimental Personality and Social Psychology

PSY 3171, PSY 3271 Psychopathology I, II 4 Q.H.

A detailed consideration of the major forms of psychopathology, including the neuroses (obsessional states, hysteria, anxiety states, phobias), the psychoses (schizophrenia, mania, depression, paranoia), psychosomatics, sociopathy, conduct disorders, organic disorders, and mental retardation.

PSY 3371 Social Psychology

Survey of theory and research in social psychology. Topics covered include attitude and attitude change, aggression, altruism, group processes, person perception, and social cognition.

PSY 3477, PSY 3577, Personality Theory and Research I, II

A survey of representative theoretical formulations of the normal personality and its development, and an examination of experimental evidence bearing upon relevant concepts and assumptions (anxiety, repression, aggression, cognitive styles).

Special Topics

PSY 3291 Research Laboratory 1 Q.H.

Students and their faculty advisers discuss laboratory projects, current literature, theory, and applications.

PSY 3419 Special Topics in Psychology max. 9 Q.H.

PSY 3521 MABA Research 0 Q.H.

Students enrolled in the M.A.B.A. program may sign up for this course beginning in their *third* year to indicate that they are continuing their research.

PSY 3549 Practicum 3 Q.H.

Supervised practicum experience emphasizing the application of principles of psychology to human behavior.

PSY 3798 Master's Thesis Continuation 0 Q.H.

Continuation of experimental work for the master's degree requirement.

PSY 3799 Doctoral Dissertation Continuation**0 Q.H.**

Continuation of experimental and theoretical work for Ph.D. candidates.

PSY 3891 Thesis**6 Q.H.**

Experimental work for the master's degree requirement.

PSY 3894 Dissertation**0 Q.H.**

Experimental and theoretical work for Ph.D. candidates.

**Boston-Bouvé College of Human Development
Professions**

Boston-Bouvé College of Human Development Professions

All courses carry four quarter-hours of credit unless otherwise indicated. Please see the current schedule for summer, fall, winter, and spring quarter listings.

Foundations of Education

ED 3828 Institute in Foundations of Education

(See general institute description on page 77.)

ED 3800 Directed Study

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the department. Not available to special students. *Prep.: Approval of the chairperson of the department and of the director of the graduate school. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

ED 3300 Psychology of Learning

The basic principles and conditions of acquisition, retention, and transfer of learning. *Suggested prep.: A course in psychology.*

ED 3301 Psychology of Thinking

A consideration of the processes involved in cognitive organization and functioning. Topics will include language, concept formation, and problem solving. *Suggested prep.: A course in psychology.*

ED 3801 Thesis

A research activity that may be selected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

ED 3302 Psychology of Personality

A systematic consideration of the personality theories of Freud, Jung, Adler, Sullivan, Horney, Cattell, Allport, Rogers, and other approaches, including the psychosomatic of Alexander and the work of Reich. Theories are considered in depth and examined for ways that contribute to an understanding of dynamic factors in personality formation. Theories and theorists are compared for a greater understanding of strengths and weaknesses. Social, cultural and philosophic questions are discussed. Implications of some of the ideas and theories for the therapeutic process will also be considered. *Suggested prep.: At least one and preferably more courses in psychology.*

ED 3303 Theories of Developmental Psychology

The major developmental theories and related research of Havighurst, Erickson, Piaget, and others. *Permission of instructor required.*

ED 3304 Child Psychology

A review of the principles of child development from birth to preadolescence. Particular emphasis

will be placed on intellectual, social, and emotional development. The theoretical formulations of psychoanalysis, social learning theory, and Piaget will be discussed in the context of relevant research in these areas, as well as their educational implications.

ED 3305 Adolescent Psychology

Social, emotional, and intellectual development in the adolescent years. Problems in family relationships and in the adolescent's social environment as well as his adjustment in school. Case history material.

ED 3306 Abnormal Psychology

An historical overview leads to contemporary views on how human personality becomes disordered and maladaptive. Principal emphasis is on the development of psychopathology during the course of development, including a perspective for viewing the economy of psychological deviations. Neuroses, transient states, character disorders, sexual deviations, psychophysiological reactions, drug and alcohol addictions, and psychotic reactions, each with a clinical picture, typical course, and outcomes are considered. Some consideration is devoted to current methods of diagnosis and treatment.

ED 3307 Adult Psychology

A comprehensive view of the three major areas of adulthood (young adulthood, middle age, and old age) in a context of research findings, academic knowledge, and clinical needs.

ED 3308 Seminar in Child Development

A seminar course with emphasis on discussion of child development theories with special reference to personality and cognitive development. Critical evaluation of research related to child development theories with particular emphasis on recent trends, new approaches, and relevance to educational theories and practices. *Prep.: A course in child psychology or human development.*

ED 3309 Seminar in Adolescent Development

A seminar course with emphasis on discussion of major problem areas facing the adolescent in our society. Particular emphasis will be given to social and emotional development. Included will be a survey of research in such areas as psychoanalysis, social learning, morality, and delinquency. *Prep.: A course in adolescent psychology or human development.*

ED 3310 Personality and Social Structure

Human behavior from a combined psychodynamic and sociological point of view, with special emphasis on socialization and the relations between the individual and the collectivity. The integration of relevant theories from psychology, sociology, and anthropology. *Suggested prep.: A course in sociology, cultural anthropology, or social psychology.*

ED 3311 Sex Roles in Education

This course identifies and examines some of the major issues related to sex roles in both the formal and informal educational systems of our society. Topics that will come under special scrutiny include development of sex role patterns in the home and preschool and through children's books, games, and television programs; life for boys and girls in the elementary and high school classroom; sex bias in counseling and in vocational guidance and training; changes in traditional family roles and occupation hierarchies; assets and liabilities of coeducational and single-sex education. The course may also allow students, in small groups, to explore their own sex role attitudes and the strategies they use to socialize young people.

ED 3312 Communications Theory

An introduction to communications theory, covering models of the communication process, attitude changes, information, innovation, dissemination and flow, communication modalities, and language processing.

ED 3320 Sociology of Education

The functioning of educational institutions in their social and cultural milieu will be examined from anthropological and sociological perspectives: the school as a social system; influence of the stratification system, youth cultures, and racial antagonisms upon the educational enterprise.

ED 3321 Educational Anthropology

Examination of schooling as a particular variety of socialization, with special attention to characteristics of societies that rely heavily on formal instruction, contrasted with less deliberately patterned techniques of child rearing. Readings will be mainly cross-cultural, ethnographic, and historical.

ED 3324 Comparative Education

Introduction to education in other nations and exploration of its relationships with the political, economic, social, and cultural milieu. Selected countries in Western and Eastern Europe, South America, and Africa will be considered.

ED 3325 History of Education

An opportunity to explore some of the historical roots of contemporary educational theory and practice with a focus on selected aspects of educational history from antiquity to the present. Also an opportunity to utilize knowledge gained for the development of a personal educational position.

ED 3326 Topics in the Philosophy of Education

A study of the basic assumptions underlying statements of educational content, process, and aims. Materials to be subjected to philosophical analysis are selected from educational and philosophic writings according to themes (e.g., authority and freedom, "growth" as an educational objective, the nature of educational relationships). The themes dealt with vary from quarter to quarter, depending on the concerns and interests of students and instructor. Brief lectures, mostly discussion.

ED 3327 Seminar in Contemporary Issues in American Education

Discussion of selected issues in contemporary American education such as school desegregation, compensatory education, learning problems of the disadvantaged, professionalization of teachers, etc. Review of relevant research and opinions. The topic or topics of the seminar for a particular quarter will be announced in the registration materials distributed in advance of that quarter.

ED 3328 Education and Equality

An investigation into the reciprocal relationship between American educational institutions and the equality-inequality dimension of American social structure. Both the traditional view, which celebrates the American public school as a triumph of equalitarianism, and the revisionist view, which emphasizes inequalitarian consequences of American educational practice, will be discussed.

ED 3340 Introduction to Educational Statistics

Basic descriptive statistics for measurement and research. Topics include use of statistical notation, measures of central tendency and variability, probability and sampling techniques, theoretical distributions, linear regression and correlation, and an introduction to statistical inference. (This course, or completion of a statistics proficiency examination, is required for admission to ED 3342 Research Design in Education.)

ED 3341 Intermediate Educational Statistics

Statistical inference of normal populations and discrete data; estimation; testing of hypotheses; multiple correlation; analysis of variance and covariance; contingency; the chi-square test and other nonparametric tests. Emphasis is given to application in educational research. *Prep.: Successful completion of the statistics proficiency examination; satisfactory completion of ED 3340 Introduction to Educational Statistics; or permission of instructor.* This course must be completed prior to doctoral candidacy.

ED 3342 Research Design in Education

An introduction to scientific methods of research in education and related fields. Stress will be placed on critical reading and understanding of

research literature, formulating research hypotheses, constructing a research proposal, and carrying out an individual or group project. This course must be included among the first six courses taken by each student. *Prep.: ED 3340 Introduction to Educational Statistics or successful completion of the statistics proficiency examination.* (Students wishing to make arrangements to take the proficiency examination should call 437-3305.)

ED 3343 Advanced Research Design

This course focuses on methodologies for collecting, interpreting, and evaluating data and deals with biases encountered in the data-collection process. Topics such as data collection and interpretation, use of sampling, analysis of variance, covariance, multiple regression, multivariate procedures, and advanced topics in scaling, semantic differential methodology, questionnaire design, interview methodology, and evaluative criteria will be featured. Students enrolling for this course will design and complete a proposal on this design for the conduct of a research project. This project may be carried out as part of research on either the master's or doctoral level. *Prep.: ED 3341 Intermediate Educational Statistics or equivalent, or permission of instructor.*

ED 3344 Nonquantitative Research Methods in Education

Nonquantitative research methods in the human development professions. Among the topics considered are problem formulation, location and selection of data, authenticity of sources, and analysis of data by synthesis. Case-study approaches and style of writing for research proposals are also discussed. *Prep.: ED 3341 Intermediate Educational Statistics.*

ED 3345 Nature and Theory of Psychological and Educational Measurement

An examination of the logic of measurement and the nature of human capacities, aptitudes, and abilities. Characteristics of tests, ratings, questionnaires, and similar instruments are reviewed with emphasis on their reliability, validity, and utility. Item analysis procedures and test standardization are covered.

ED 3346, 3347 Independent Research Seminars I and II (4 Q.H. each)

Focus is on the design, conduct, analysis, and reporting of data from an individual research project. This project may be original or secondary, applied, theoretical, or action research and must be substantially larger in scope than that accommodated by Directed Study. Evaluation will be based on oral and written interim reports in Seminar I and oral and written final reports in Seminar II. This course will serve as an option to the thesis requirement only for students enrolled in the master's degree program in Educational Research.

INT 3549 Introduction to Computer Programming: FORTRAN

A laboratory course designed to develop facility in the use of a wide range of data-processing equipment in educational research. Students will be introduced to the basic principles of computer programming, but emphasis will be placed on the applicability and use of existing statistical programs.

ED 3820 Workshop in Foundations of Education (See general workshop description on page 77.)

Curriculum and Instruction

ED 3801 Thesis

A research activity that may be elected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

ED 3414 Seminar in Supervision of Instruction/Reading

This seminar examines the role of the supervisor and consultant in organizing and implementing programs. Aspects include organizational plans, staff supervision and development, working with parents, and accommodating special needs children.

ED 3415 Seminar in Supervision of Instruction Practicum (8 Q.H.)

Students apply the skills learned in the seminar to a field setting. Student field work is supervised by an on-site person and a professor. At periodic seminars, projects are selected and discussed. Students plan the projects and implement these in the field. Students also plan and carry out a project evaluation.

ED 3825 Institute in Elementary Education (See general institute description on page 77.)

ED 3826 Institute in Secondary Education (See general institute description on page 77.)

ED 3800 Directed Study

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the department. Not available to special students. *Prep.: Approval of the chairperson of the department and of the director of the graduate school. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

ED 3486 Developing Multimedia Learning Packages

During this course each student will produce a multimedia (print and nonprint) instructional package for individualized learning.

ED 3482 Principles of Programmed Instruction

The development and current status of self-instructional devices. A survey of available programs and teaching machines, including audiovisual machines, with emphasis on the details of the construction and evaluation of programs.

ED 3456 Teaching Reading to the Deaf

Modern methods in use, such as the Fitzgerald Key and the Natural Language Approach. Emphasis is on using language in natural situations through lip reading and writing, with later emphasis on the formal presentation of language principles. Methods used to develop reading experiences that focus on content rather than mechanics are also covered as well as considerations appropriate to the development of a balanced reading program that provides adequate motivation, a wide variety of rich materials, a well-organized sequence of reading experiences, and provisions for evaluation.

ED 3404 Methods and Materials for Teaching Adolescents and Adults I

Consideration of specific methods and materials appropriate to teaching adolescents and adults to develop in the students an understanding of the complexities of the materials and methodology of the teaching-learning process, to encourage within students attitudes conducive to and identified with good tenets of teaching, and to foster in the students acceptance of the need to grow constantly and to be aware of the continuing development of our knowledge of the learning-teaching process.

ED 3450 Foundations of Developmental Reading

Reading and writing as the receiving and generating of language; current developmental reading, writing, and related language skills; selected research findings bearing on relevant topics. (This course includes ten hours of observation or other field experience.)

ED 3423 Language in the English-Language Arts Curriculum

An examination of the multiple dimensions of language study in the English-language arts curriculum; the role of inquiry in the study of language and its implications for the English-language arts curriculum; theories of grammar and their relation to the study of language in the English-language arts curriculum; the interrelatedness of language and the other components of the English-language arts curriculum. Each student will identify and investigate an area of individual interest. *Prep.: ED 3420 The English-Language Arts Curriculum or permission of instructor.*

ED 3400 Analysis of the Instructional Process

A consideration of the rational basis for effective teaching and the nature of the educational process. Learning theory is related to the various strategies and activities that can be implemented within a learning situation to meet the needs of the learners, including those with special needs. Alternative approaches, research results, and theoretical constructs are employed to help extend the prospective teacher's concepts of the educational process and the role of the teacher in it.

ED 3401 Fundamentals of Curriculum Development

An examination of how goals and objectives are selected and how priorities are determined. Methods of designing educational programs to meet specified goals and methods of evaluating educational outcomes in terms of the goals of the program and techniques for modifying programs in the light of such performance.

ED 3402 Methods and Materials for Teaching Children I

Teaching methods and learning materials used in teaching children in a number of educational settings. This course will help students establish objectives, plan and execute appropriate learning experiences, and evaluate outcomes.

ED 3403 Methods and Materials for Teaching Children II

A continuation of ED 3402. *Prep.: ED 3402 Methods and Materials for Teaching Children I.*

ED 3405 Methods and Materials for Teaching Adolescents and Adults II

This course provides for the specific subject areas to be attended to. Topics covered include techniques of organizing and presenting lessons, developing teaching materials, using audiovisual equipment, developing and implementing evaluation instruments, and selecting appropriate materials within each field of interest. (15 hours of field work required.)

ED 3406 Procedures of Evaluation

Consideration is given to evaluation as a process for the improvement of learning and instruction. The course concerning itself with such topics as how to measure and evaluate effective, psychomotor, and cognitive dimensions of student growth; test construction; collecting and administering standardized tests; various bases of grading; and methods of reporting student progress.

ED 3407 Student Teaching with Related Seminar (8 quarter hours)

A University-arranged practicum of observation and teaching in schools offering comprehensive programs within reasonable commuting distance of the University. Participating on a full-time basis, the student is expected to develop planning and communication abilities within his major field. Biweekly seminars at the University provide additional opportunity to analyze theory-practice relationships and to examine generic problems of teaching. *Prep.: Course in child or adolescent psychology; successful completion of all course work in the nondegree program.* (Open only to students in the nondegree Curriculum and Instruction program.)

ED 3408 The Evolution of Curriculum Theory and Practice

Examination from a historical perspective of the curriculum of the American school as an evolutionary process resulting in part from conflict between subject-oriented and student-oriented curricula, traditionalists and revisionists, behaviorism and psychodynamism, and the interplay of forces generated by students, teachers, administrators, and other interested groups. Present curricula will be analyzed as the outcomes of such influences and trends for future developments will be hypothesized. Hence, the course will also focus on the process of curriculum development and the product of that development.

ED 3409 Seminar in Curriculum: Alternative Designs

Identification and analysis of problems in curriculum and instruction in light of the forces affecting the curriculum within the student's area of specialization; design and implementation of solutions to such problems; evaluation and field testing, where feasible, of these solutions. *Prep.: ED 3408 The Evolution of Curriculum Theory and Practice.*

ED 3411 Seminar in Instruction: Alternative Designs

Methods of inventing or adapting methods of teaching to make them appropriate to the demands of the curriculum, the needs of the students, the capabilities of the teachers, the expectations of the community, and the resources of the school or college. This course will help the student identify the criteria by which instructional

practices may be selected, by which they may be evaluated, and by which they may be developed. Instructional practices include methods of teaching, designing learning materials, grouping students, pacing, scheduling, and evaluating. Students will have the opportunity to revise existing resources and to create new resources for instruction in order to make the implementation of a specific curriculum more effective. *Prep. (except for students in joint programs with a department in another college): ED 3409 Seminar in Curriculum: Alternative Designs (may be taken concurrently); Prep. for students in joint programs with a department in another college is ED 3400 Analysis of the Instructional Process or equivalent.*

ED 3412, 3413 Seminar in the State of the Art and Field Project (8 Q.H.)

Students will examine the current curricular and instructional issues in specific teaching areas or levels, hypothesizing and projecting possible future directions in curriculum and instruction in these areas; integration of the results of these inquiries into coherent understandings of the state of the art in these areas and the development of a special project to be implemented by the students within the context of their own teaching experiences. Seminars will be held over a period of two quarters every other week. *Prep.: Teaching experience.*

ED 3420 The English-Language Arts Curriculum

The design and function of the English-language arts curriculum; selected current issues as they impinge upon the English language arts curriculum; the design and function of research in the English language arts curriculum. Open to certified or experienced teachers. *Prep.: Permission of instructor.*

ED 3421 Literature in the English-Language Arts Curriculum

The historical-social, psychological, personal, archetypal, textual, biographical, and philosophical-moral aspects of literary study and their relation to the chronological, thematic, and generic demands of the literature program; the sources of interest in literature as they relate to the young reader and their implications for the English-language arts curriculum; the interrelatedness of literature and other components of the English-language arts curriculum. Each student will identify and investigate an area of individual interest. *Prep.: ED 3420 The English-language arts curriculum or permission of instructor.*

ED 3422 Writing in the English-Language Arts Curriculum

The cognitive and effective bases of imaginative and nonimaginative writing; the role of writing in the relationship between self and object; modes of imaginative and nonimaginative writing appropriate to the young writer; the impulse to expression

in the young writer and its implications for the English-language arts curriculum; the interrelatedness of writing and other components of the English-language arts curriculum. Each student will identify and investigate an area of individual interest. *Prep.: ED 3420 The English-language arts curriculum or permission of instructor.*

ED 3424 Topics in English-Language Arts Education

An investigation of a matter of immediate concern to English-language arts education, but for which no organized study is ordinarily available. Typical topics include media in the English-language arts program, behavioral objectives in the English-language arts program, the English-language arts program for the disadvantaged. Each year the seminar topic for that year is announced prior to registration.

ED 3425 English as a Second Language I

First course in teaching ESL, introducing the basic linguistic, cultural, and psychological concepts. Analysis of current approaches to teaching ESL locally and internationally from the standpoint of diagnosis, grouping, use of particular methods, and materials. Observations of local ongoing ESL programs will be included. *Prep.: ED 3453 Diagnosis and Remediation of Reading and Language Disabilities I or permission of instructor.*

ED 3426 English as a Second Language II

Second course in the ESL sequence which emphasizes innovative means in teaching ESL. Specific projects according to student need and interest will be developed; supervised clinical work. *Prep.: ED 3425 English as a Second Language I.*

ED 3427 Literature and Materials Seminar

Literature for children, adolescents, and adults; the sources of interest in literature as they relate to the reader; the interrelatedness of literature and other components of the language arts program; investigation of materials available. Students will develop projects related to their needs and interests.

ED 3430 History and the Social Studies in the School Curriculum

Permits the student to explore some of the fundamental concepts of anthropology, sociology, economics, political science, and history. Emphasis will be given to the interrelatedness of disciplines and to the extraction of operating principles from those that aid in the analyses of social problems. As a consequence of such analyses, the student should be equipped to find a greater variety of conceptual relationships within the historical social science field. From there a framework for evolving courses of study may be generated. *Prep.: Teaching experience or certification.*

ED 3431 Social Science Materials Seminar

A curriculum course wherein the knowledge previously acquired will be used to establish criteria for the selection and development of curriculum materials. All materials of instruction will be viewed as means of implementation of objectives relating to specific social science concepts and skills. An effort will be made to personalize and concretize abstract phenomena and to demonstrate their impact on the quality of human lives. Students will examine and analyze prepared curricula and will be asked to develop original materials that include provision for the integration of a variety of thinking, reading, and social skills. *Prep.: Teaching experience or certification.*

ED 3432 Seminar in Current Issues in the Social Studies

A content approach to problems of political, economic, and social significance which have contemporary relevance for teachers of the social sciences.

ED 3440 Remediation in Mathematics

An effective approach to the teaching of mathematics; diagnosis and remediation of difficulties, alternative teaching methods, techniques for the improvement of student skills and of student attitudes toward mathematics.

ED 3442 Seminar in Mathematics Education

Students are expected to analyze a mathematics learning problem, to investigate relevant research, and to prepare materials embodying their own proposed solutions. *Prep.: Permission of instructor.*

ED 3451 Language and Reading

Introductory course in linguistics with emphasis on implications for reading and language instruction. Topics include the nature of language, introduction to the development of syntax, phonology and semantics, English orthography, the grammar of child language, and dialectology. *Prep.: ED 0450 Foundations of Developmental Reading or consent of instructor.*

ED 3452 Current Issues in Reading and Language

Three or four topics of current interest in reading and language education are investigated in depth over a three- or four-week period each during the quarter. Typical topics might include lectures and reading on sexism in reading materials, Chapter 766 and its implications for reading and language education, "back to basics," reading and language in the open and alternative education program, problems of illiteracy, bilingual and bicultural education and reading/language instruction.

ED 3453 Diagnosis and Remediation of Reading and Language Disabilities I

Reading and language disabilities; causes and correlates of disability; language differences;

aspects of measurement; diagnostic and corrective procedures in reading, writing, and related language skills; selected research findings bearing on relevant topics. *Prep.: ED 3450 Foundations of Developmental Reading.*

ED 3454 Diagnosis and Remediation of Reading and Language Disabilities II

Second course in Reading and Language Disabilities, including an examination of selected models of language processes; cognitive and effective dimensions; problems in language pathology; and other learning disabilities, including academic, perceptual-motor, and neurological areas. *Prep.: ED 3453 Diagnosis and Remediation of Reading and Language Disabilities I and ED 3457 Clinical Practicum in Reading.*

ED 3455 Teaching Reading in Junior and Senior High School

Developmental or corrective reading programs at the secondary level. Development of reading rate, comprehension, interpretation, and study skills in the content areas.

ED 3457 Clinical Practicum in Reading

Practicum in clinical experience, tutoring children and adults with severe reading disabilities in the Reading Clinic for a total of seventy hours under close staff supervision. A one-hour seminar follows each tutoring session for purposes of discussion and case presentation. Diagnosis, lesson plans, daily logs, complete case history, and final progress evaluation are required of each student. *Prep.: ED 3450 Foundations of Developmental Reading.*

ED 3458 Field Practicum in Reading

Eighty-hour field practicum offers students the opportunity to apply consulting and remediation skills in a school setting. Students may consult with teachers on the implementation of developmental and corrective reading and on reading in the content areas and also may provide diagnostic and remediation to pupils having special needs in reading. *Prep.: ED 3453 Diagnosis and Remediation of Reading and Language Disabilities I and ED 3457 Clinical Practicum in Reading.*

ED 3461 Bilingual Education, Methods, and Materials

An introductory course in the problems, programs, and principles of bilingual/bicultural education. Emphasis will be on the current methods and materials used in programs nationally and internationally. Curricular aspects of bilingual/bicultural programs will be studied, as well as available research. *Prep.: SOA 3135 Language and Communication, ENG 1118 Introduction to Linguistics, ENG 3404 Language and Its Structure, ED 3451 Language and Reading, or SLA 3650 Social Dialectology.*

ED 3462 Seminar: Ethnicity and Today's School Curriculum

Students will briefly review aspects of the history and culture of some ethnic groups to explore the unique manner in which certain universal needs are manifested. Prepared curricular materials, as well as authentic literary, visual, and artifact materials, will be analyzed, evaluated, and related to developed criteria, goals, and potential curricular impact in projecting the aforementioned cross-cultural needs or themes. Students will be asked to select, organize, and, as necessary, develop independent materials and strategies appropriate for classroom use. Efforts will be made to categorize developed units of work on various ethnic groups which appear to have significant parallel dimensions according to predetermined categories.

ED 3463 Urban Education: An Introduction to Teaching in City Schools

An introductory course offering students an overview of urban education, especially in the public schools. The demography of city schools is studied as a basis for identifying diverse special education needs of the multicultural population, such as ESL, bilingual education, and ESD. Study includes an overview and investigation of current curricular patterns related to this area of education. Readings, guest speakers, and first-hand observations of selected schools and programs are included in the course content.

ED 3470 Teaching Adults: Methods and Materials

Designed to help prepare participants to instruct adults in a variety of academic and nonacademic settings, the course emphasizes the skills and knowledge necessary to identify objectives, plan and execute appropriate lesson plans in keeping with students' requirements, develop curricula in a variety of settings, and evaluate students' performance. Class activities include the presentation of both theory and application through selected case studies that exemplify adult teaching in different environments. Participants also have the opportunity to acquire the necessary skills for developing individual models of adult teaching behavior to suit various circumstances.

ED 3471 Methods and Materials in Adult Literacy

This course will introduce students to some current diagnostic and instructional approaches to the functionally and totally illiterate adult. Current methods and materials will be analyzed and evaluated. Special projects may include the development of informal diagnostic instruments and/or instructional materials for particular adult learners. An overview of national and world literacy problems and programs will also be offered.

ED 3484 Selection and Utilization of Instructional Material

This course deals with all aspects of instructional media, surveying types, techniques, advantages, limitations, sources, and methods of using materials and equipment in specified areas. Emphasis is on the selection of appropriate media (print and

nonprint) to suit given learning objectives. Laboratory experience in operation of equipment and the production of instructional materials is provided.

ED 3821 Workshop in Elementary Education

(See general workshop description on page 77.)

ED 3822 Workshop In Secondary Education

(See general workshop description on page 77.)

Educational Administration

ED 3823 Workshop in Administration

(See general workshop description on page 77.)

ED 3501 Leadership in Education, Part II

Part II continues an emphasis on the leadership function in organizations. It examines selected informal organization elements such as motivation, normative order, social power, conflict, conformity, and creativity. Attention is given to processes of change and innovation in organizations. *Prep.: ED 3500 must be completed before enrollment in ED 3501.*

ED 3801 Thesis

A research activity that may be selected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

ED 3500 Leadership In Education, Part I

Part I of a two-term core course designed to introduce the student to concepts of formal organization. This core, consisting of a two-part sequence, is prerequisite to further study in the Department of Educational Administration. Part I may provide the student with an overview of formal organizations as social systems, with emphasis given to the leadership function. Relationships between individuals and organizations are considered. Communications and decision-making functions are analyzed and examined.

ED 3502 Instructional Leadership: Curriculum Development and Supervision

This course views the responsibilities of administrative personnel relating to the improvement of curricular and instructional practices. Evaluative techniques, inservice education, supervisory procedures, and innovative programs are among the areas of consideration. Students may have the opportunity to become engaged in supervisory projects individually or in small teams. *Prep.: ED 3500 and ED 3501, or permission of instructor.*

ED 3506 Administration of Early Childhood Education

This course will include the study of significant elements of administration unique to the planning, implementation, and operation of an early child-

hood education center. Areas of concern are funding sources, intra-institutional relationships, patterns for designing early childhood programs, on-site visitations, modes of private governance, use of plant, student and teacher placement, role of volunteers, and related topics. *Prep.: ED 3500 and ED 3501.*

ED 3507 Administration of the Elementary School

A survey of the operational tasks performed by the elementary school administrator. Included will be school-community relations, student personnel, staff personnel, curriculum and instruction, physical facilities, finance and business management, and organizational structure. *Prep.: ED 3500, ED 3501, or permission of instructor.*

ED 3508 Administration of the Secondary School

A survey of the operational tasks performed by the secondary school administrator. Included will be school-community relations, student personnel, staff personnel, curriculum and instruction, physical facilities, finance and business management, and organizational structure. *Prep.: ED 3500, ED 3501, or permission of instructor.*

ED 3511 Administration of Cooperative Education

An examination of significant elements in the planning, implementation, and operation of a cooperative education program. Areas of concern include agents for institutional change, intrainstitutional relationships, program costs and funding sources, cooperative education calendars, development of cooperative work assignments, relationships with cooperative employers, and operational policies.

ED 3517 Simulated Problems: Elementary School Administration

The course is designed to place each student in a simulated decision-making situation as a principal or administrator of an elementary school. Background materials have been prepared which describe all aspects of a school system, including its publics, its policies, its certified and noncertified staff members, and its geographical and socioeco-

conomic makeup. These background data may be disseminated through motion pictures, film strips, and taped interviews with influential people in the community, as well as through written materials. *Prep.: ED 3500, ED 3501, or permission of instructor.*

ED 3518 Simulated Problems: Secondary School Administration

The course is designed to place each student in a simulated decision-making situation as a principal or administrator of a secondary school. Background materials have been prepared which describe all aspects of a school system, including its publics, its policies, its certified and noncertified staff members, and its geographical and socioeconomic makeup. These background data may be disseminated through motion pictures, film strips, and taped interviews with influential people in the community, as well as through written materials. *Prep.: ED 3500, ED 3501, or permission of instructor.*

ED 3522 Simulated Problems: Administration of Occupational and Career Education

Each student is confronted with a series of simulated decision-making situations such as those which are usually faced by administrators of programs in the area of occupational and career education. Readings, audiovisual material, and class interactions constitute the design of this course.

ED 3827 Institute in Educational Administration (See general institute description on page 77.)

ED 3523 Seminar in Educational Administration
A culminating experience for students majoring in school administration at the master's level. The student is confronted with major issues facing the school and its administrators. Emphasis is placed upon applying knowledge gained in previous administrative courses to an understanding of contemporary education problems. *Prep.: ED 3500, ED 3501, or permission of instructor.*

ED 3524 Seminar in Occupational and Career Education

Students will be confronted with a sampling of the major issues facing administrators and supervisors of occupational and career education programs in their efforts to organize, promote, and operate such programs. Emphasis will be placed on applying the knowledge acquired in previous courses and other program experiences to arrive at an understanding of contemporary occupational and career education problems and their solutions.

ED 3543 Directed Field Experiences in the Administration of the Elementary School

Required of all master's candidates who major in school administration. Study and discussion of administrative functions may be coordinated with selected field trips to administrative settings and

with guest lectures by practicing elementary school administrators. These experiences usually involve visits to such settings as an elementary school, a middle school, a superintendent's office, a school committee meeting, and appropriate federal and state agencies. In addition, each student will be expected to participate in an administrative field experience in an elementary setting for a minimum of four hours per week. *Prep.: ED 3500 or permission of instructor.*

ED 3544 Directed Field Experiences in the Administration of the Secondary School

A companion course to ED 3543, required of all master's candidates in school administration. Study and discussion of administrative functions may be coordinated with selected field trips to administrative settings and with guest lectures by practicing secondary school administrators. These experiences are aimed at educational agencies at the secondary level and may include visits to a comprehensive high school, a junior high school, a regional vocational-technical school, a superintendent's office, a school committee meeting, and appropriate federal and state agencies. In addition, each student will be required to participate in an administrative field experience in a secondary school for a minimum of four hours each week. *Prep.: ED 3500 or permission of instructor.* (ED 3544 may be a continuation of ED 3543 or may precede it.)

ED 3800 Directed Study

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the department. Not available to special students. *Prep.: Approval of the chairperson of the department and of the director of the graduate school. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

CAGS and Doctoral Course Offerings in Educational Administration

(Open only to CAGS and doctoral degree candidates or by special permission of the department chairperson, granted prior to registration.)

ED 3348 Research and Statistical Methods for Administrators

A study of the application of the methods of research and statistical techniques to problem solving, with specific focus on the role of research in the administrative decision-making process. The course of study may also focus on the various research designs administrators may use in their positions, such as the development of a program proposal for local, state, or federal agencies. A specific topic of practical significance in administration is to be selected by the student and a de-

sign for studying the topical problem developed. Research relevant to the topic is evaluated. *Recommended prep.: Rudimentary knowledge of research designs and techniques and an elementary knowledge of basic statistical methods.*

ED 3503 Current Issues in Educational Administration

A seminar required of all students pursuing the CAGS. Critical and contemporary issues which face administrators will be examined. The status of the administrator; federal, state, and local revenue sources; accountability; teacher militancy; equal educational opportunity; control of schools; and urban education problems are examples of topics that will be analyzed.

ED 3504 Human Relations Skills for Administrators

This course offers students the opportunity to examine methods of diagnosing problems and responding in management contexts; analyzing the norms, influence patterns, roles, and control systems of organizations; performing some of the critical skills required in the leadership of human organizations; and managing an intervention for the purpose of solving an organizational problem. *Prep.: CRS 3405 Group Dynamics or equivalent.*

ED 3505 The Process of Administration

A course required of all students pursuing the CAGS. Case analysis and group activity will be utilized to gain insight into such areas as the improvement of organizational morale, professional job satisfaction, and current issues of involvement and conflict. Students will also examine alternative courses of action to cope with problematical events confronting educational administrators.

ED 3509 Administration of Two-Year Colleges

Emergence of the community college movement in the United States, administrative structures and governance, the role of faculty in planning, the student population and related student personnel services will be examined. Particular emphasis is placed upon the identification and utilization of community resources in curriculum development and the college's total relationships with the community in which it exists. The two-year technical institute and both publicly and privately supported junior colleges will be studied. Field visits are an integral part of course requirements.

ED 3510 Academic Administration in Higher Education

Recruitment of properly qualified faculty and staff is only one problem of the academic administrator. This course will also consider the problems of pupil services, admissions, athletics, curriculum development, accreditation, instructional resources, registration and scheduling, faculty organization, continuing education, faculty rights and responsibilities, and personnel policies.

ED 3512 Administration of Adult and Continuing Education

The historical development of adult and part-time education, with attention to the present status and trends for the future, will be studied, with emphasis on the administration of these programs. A variety of adult educational programs in schools, colleges, junior colleges, religious agencies, social service organizations, business and industry, and professional organizations will be included, focusing on planning, implementing, administering, financing, and evaluating such programs.

ED 3515 The Administrator's Role in Supervision and Evaluation

The course examines the leadership role as it relates to supervision and evaluation. Through role playing, case analysis, and the use of videotapes, students have the opportunity to engage in activities typically required of building or unit administrators. A variety of supervisory and evaluation techniques and formats appropriate to both formative and summative evaluations are presented for examination.

ED 3516 Administration and Supervision of Special Education

Designed for advanced graduate students preparing for administrative or supervisory positions in special education programs. Facilities and curriculum adjustments, staff roles, methods and content for in-service training, and the use of the team approach are studied. Field trips to observe and evaluate programs may be required.

ED 3521 Problems in College Administration: A Simulated Experience

This seminar is designed to place each student in simulated decision-making situations as an administrator of a college or junior college. Background materials have been prepared which describe many aspects of a college, including its policies, the makeup of its faculty and student body, its financial situation, the community it serves, and its board of control. *Prep.: ED 3528 Financial Management in Higher Education or permission of instructor.*

ED 3513 Problems in Urban School Administration

This course examines the problems of educational administration in the complex city school system with emphasis on solutions to educational problems caused by the unique demographic characteristics of the city.

ED 3525 Personnel Administration

The purposes, patterns, and issues in personnel administration are the major considerations of the course. Study will include the skills, attitudes, and knowledge which an institutional staff needs to have and which are essential to the accomplish-

ments of organizational goals. Personnel administration programs and problems will serve as the focus for the course.

ED 3526 Educational Finance

The study of school finance deals with the principles and problems of financing education, and also considers the basic concepts of economics relative to the place of school finance in the field of public finance. The sources and rationale for public support of schools are examined. Selected state and federal aid programs, capital outlay programs, current practices and issues of local support, and bond issue campaigns are included in this study.

ED 3527 School Business Management

Practices and issues in the administration of school business affairs are the major concerns of the course. The role of the school business administrator and the educational budget will be examined. Attention will be paid to principles of budget preparation and development, purchasing, supply management and distribution, school accounting and data-processing systems, auditing, financial reporting and management of payroll, transportation programs, and school food services, and the operation and maintenance programs for the physical plants. In addition, each student will be placed in a simulated decision-making situation. Background materials have been prepared describing aspects of a fictitious school system, including its publics, policies, and other relevant information. Each student may have the opportunity to deal with matters typically faced by the school business administrator.

ED 3528 Financial Management in Higher Education

This course seeks to combine a knowledge of fund-raising activities with the study of proper financial management in higher educational institutions. The problems of fund raising for both public and private, two- and four-year institutions will be considered. Modern techniques of budget preparation and control may include purchasing, school accounting, data processing, providing benefits for faculty, financial reporting, food services, housing, and operation and maintenance of the physical plant.

ED 3529 School Plant Planning, Operation, and Maintenance

This course seeks to have the student develop a basic understanding of the processes involved in the planning, maintenance, and operation of school plants. Such items as educational specifications, the process of school construction, techniques for providing clean, safe, and healthy environments for the teaching-learning process, along with the selection, assignment, and supervision of custodial and maintenance staff will be involved. Statutes or regulations pertaining to these processes used by state and local regulatory

bodies will also be reviewed. Consideration will be given to issues related to declining enrollments and school closings.

ED 3530 Institutional Planning and Facilities

This course will consider the planning of new colleges as well as the expansion and maintenance of existing ones. Systems analysis, needs surveys, and development of educational specifications for college facilities will constitute half of the course. The other half will involve studying the operation and maintenance of the physical plant, including provisions for housing, safety, parking, communications, and health service.

ED 3531 Systems Theory in Education

This course is required of all students pursuing the CAGS. The course provides the student with an introduction to general systems concepts and terminology as well as the implications of systems theory to leadership and administration. Topics include systems applications such as input/output analysis, PERT, feedback monitoring and response, flowchart logic, and the computer as a system. Consideration is given to systems study as a method of planning and evaluation.

ED 3532 Organizational Analysis

Open only to advanced graduate students, this course will include examination of different approaches used to define traits or characteristics of formal organization. Special emphasis will be placed on the application of models, typologies, and schemes to identify structural or procedural deficiencies in bureaucratic social systems. *Prep.: Permission of instructor.*

ED 3534 School-Community Relations

This course includes the study and design of school-community relations programs based on the principles and practices of the intercommunications between the school and its several publics. Selected research findings relative to public relations programs in business, industry, and governmental agencies will be reviewed in addition to those involving educational systems. Stress will be placed on the role of the administrator in the development of a comprehensive program of school community relations to the administrative unit.

ED 3535 School Law

The student will be expected to develop a basic understanding of federal and state laws that apply to school systems, educational programs, and personnel, as well as of the legal prerogatives available to the practicing administrator and the local boards of education. This study will include consideration of the constitutional, statutory, and common-law foundations of educational systems and the school administrator's role with respect to them.

ED 3536 Collective Negotiations in Education

This course is designed to provide prospective administrators and those already engaged in

administration with knowledge of the collective negotiation process and collective negotiation strategies and tactics. Designed as a systems approach to collective negotiations, simulation exercises and cases will be used to provide practical exercises for students. When arrangements can be made, guest lecturers experienced in collective negotiations will be invited to the seminar.

ED 3537 Program Planning and Workshop Design

Administrators who wish to be effective must know the techniques for directing client-needs assessment. This course presents a variety of strategies designed to help students develop skill at assessing client needs, followed by discussions regarding ways in which these needs are translated into program/workshop objectives. The administrator's role in program and workshop design, with emphasis on managing the learning activities, is demonstrated through student involvement in administrative activities. Attention is devoted to the variety of settings in which adult education administrators work, including educational institutions, business and industry, governmental agencies, and human-service organizations.

ED 3538 Securing and Administering Grants in Education

This course is designed to provide school administrators with knowledge of fund raising for educational purposes and supervisory techniques for funded programs. Designed as a systems approach to grantsmanship, the course will emphasize the methods and techniques of fund raising, program planning, and proposal writing.

ED 3540 Typologies of Higher Education

A study of the types of higher educational institutions, with emphasis on organizational structure, modes of governance, and administration. The history of higher education, particularly the development of colleges, universities, and junior colleges in the United States, will be considered to provide perspective for the modern college administrator. Important issues and the problems they present for administrators will provide the major focus of this course.

ED 3541 Innovation and Change

A course required of all students pursuing the CAGS. Major emphasis is upon administrative strategies in effecting structural alterations, curricular organization, and instructional techniques. The nature of these alterations varies with the particular problems relevant to the issues that receive consideration.

ED 3542 Politics and Educational Decision Making

This course examines federal, state, and local governmental arrangements and political processes which influence educational policies of school

systems. Emphasis is given to the application of political science concepts and research methods to educational policy-making processes and to the political environment surrounding the educational administrator.

ED 3545 Administrative Internship

This is an individualized offering involving supervised observations, internships, externships, and seminars in educational administration. It is designed to provide further practical experience in the student's area of administrative preparation. The administrative internship program must be worked out with the adviser not later than the end of the second week of the quarter preceding the quarter during which the internship will take place.

ED 3546 Special Education Administrative Internship

An individualized offering for students preparing for administrative roles in areas of special education. The course offers experiences in supervised observations, internships, externships, and seminars in special education administration. The administrative internship program must be worked out with the student's adviser not later than the end of the second week of the quarter preceding that in which the internship is to take place.

ED 3800 Directed Study

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the department. *Not available to special students. Prep.: Approval of the chairperson of the department and of the director of the graduate school. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

ED 3806, 3807, 3808 Doctoral Seminar in Leadership; Administration and Supervision I, II, III

A series of three seminars required of all students pursuing the Ed.D. degree. The dialogues in these courses will use an interdisciplinary approach to explore complex behavioral and structural interactions found in formal organizations. Major emphasis will be placed upon integrating theoretical concerns with practical administrative functioning.

This sequence of seminars is viewed primarily as a pooling of the results of extensive individual student research and activities and is aimed at giving the student an overview of all aspects of the institution he or she will be leading. (These seminars open only to students who have been accepted to a doctoral program.)

ED 3809 Doctoral Dissertation

Prep.: Admission to candidacy in the Doctor of Education degree program.

Counselor Education

CRS 3513, 3514 School Psychology Fieldwork I and II (8 Q.H.)

The first phase of a two-year sequence of supervised fieldwork required for school psychologist certification. Students are assigned a placement in an N-12 school system working under the supervision of a certified school psychologist. The activity of the fieldwork will extend for two days a week across the academic year from September to June. Students perform psychological evaluations and participate in other appropriate activities. Seminars meet for twenty-four sessions during the year to provide skill training and discuss role functions. Students receive one hour of supervision per week from the field site supervisor. Students must submit an application for a fieldwork placement by April 1 for approval for the course which begins in the following fall quarter.

CRS 3515, 3516 School Psychology Fieldwork III, IV (8 Q.H.)

The second phase of a two-year sequence leading to eligibility for application for school psychologist certification. The student will be assigned typically to a different N-12 grade placement than the first experience to provide a diversified experience. The placement is for two days per week from September to June. Seminars meet twenty-four times across the academic year and consist of case presentations, skill and strategy training, and discussions of case management. Students work under and receive one hour of supervision from their certified school psychologist site supervisor. Students must submit an application for fieldwork by April 1 for approval to enroll in the fieldwork course the following fall quarter. *Prep.: CRS 3513, 3514, School Psychology Fieldwork I and II.*

CRS 3539 Advanced Theories of Behavior Change II

This course addresses the fundamental methods for constructively improving human behavior, as implicit within the three generic approaches to psychological theory construction, and provides an overview of Ludwig von Bertalanffy's general systems concept of psychology and its relations to allied sciences. The course is based on a format of selected readings, lectures, and student discussion. *Prep.: CRS 3538 Advanced Theories of Behavior Change I.*

CRS 3550 Philosophy of the Behavioral Sciences

Addresses such fundamental questions as "What is science? What are its essential methods of inquiry, particularly as they pertain to the behavioral sciences? What is the nature of knowledge gained through scientific investigation, and are there limits to its usefulness?" Participants have the opportunity to examine the natural and empirical sciences through exploring theory, fact proposi-

tions, hypothetical deductive/inductive knowledge, laws, evidence, verification, reductionism, and allied ideas. *Prep.: ED 3342 Research Design in Education and CRS 3539 Advanced Theories of Behavior Change II.*

CRS 3801 Thesis

A research activity that may be selected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

CRS 3808 Doctoral Dissertation

Prep.: Admission to candidacy in the Doctor of Education degree program.

CRS 3800 Directed Study

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the department. *Not available to special students. Prep.: Approval of the chairperson of the department and of the director of the graduate school. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

CRS 3500 Foundations in Professional Psychology and Human Services

The purpose of this course is to provide a philosophical and theoretical background for beginning graduate students in counseling. The course has three objectives: 1) to sharpen the "self as instrument" through study and discussion of established theories of helping related to one's personal value system and through self-exploration and increased self-understanding in heretofore unexplored personal areas; 2) to introduce students to the broad spectrum of professional helping service areas with the intent of clarifying the students' professional roles; and 3) to begin to promote the development of a professional identity as a psychological helping professional.

CRS 3501 Psychological Testing

The principles and problems of psychological testing as applied to the work of the counselor are discussed. Consideration is given to technical concepts applicable to the use, understanding, and interpretation of test scores. Students have the opportunity to become familiar with the most frequently used tests of intelligence, aptitude, achievement, interest, and personality. Tests are evaluated for use in diagnosis and in understanding human behavior, with emphasis on their interpretation.

CRS 3502 Vocational Development and Occupational Information

A dual-emphasis course dealing, first, with theories about the ways in which individuals make decisions concerning their choice of vocation; and second, with the kind of data which are

needed to assist people with these decisions. These requisite data deal with the relationship of social and economic change to occupational trends, the classification and description of occupational fields, methods of collecting, evaluating, filing, and disseminating vocational information, and the role of the counselor in fulfilling these functions.

CRS 3503 Counseling Theory and Process

A required course for all Counselor Education degree candidates which must be taken in the fall quarter, concurrently with the beginning of Practicum. The course will provide the student with a basic cognitive understanding of several major theoretical approaches to counseling. Classroom content will help students to become familiar with a wide range of individual counseling strategies, to develop listening, understanding, and communications skills, and to further probe their own self-understanding as counselors. These skills and understandings will be discussed and simulated in the context of a variety of settings with a variety of clients. Role playing, case material, and audio and video materials will be utilized in the instruction. This course will not be open to special students, but may be selected by degree candidates in other departments in any quarter except the fall quarter.

CRS 3504, 3505 Counseling Practicum I and II

The counseling practicum is a supervised counseling experience extending over the academic year. Although registration for this course occurs only during the winter and spring quarters, students will actually begin their practicum in the fall quarter. Emphasis in the fall will be on small-group seminars dealing with counseling and other related matters. The winter and spring quarters will concentrate on the supervised counseling assignment. Assignment to practicum settings will be made according to the student's major area of concentration. Students must make themselves available a minimum of two days per week during the academic year (October to June) for placement in a field setting. Seminars will stress material germane to the student's major and will meet a total of twenty-four times during the year. CRS 3504 must be successfully completed prior to commencing CRS 3505. (For administrative purposes, these practicum course numbers will apply to each of the following specific practicum placements: School Practicum (N-9, 5-12), Counseling Psychology, Career/Industrial, Student Personnel/College Practicums.)

Part-time students must submit an application for practicum (available from the department) by April 1, for approval to enroll in the practicum the following fall quarter. *Prep.: CRS 3500 Founda-*

tions in Professional Psychology and Human Services and CRS 3503 Counseling Theory and Process, both of which may be taken concurrently with the beginning of practicum.

CRS 3507 Group Counseling

An introduction to theory, principles, and techniques of counseling with groups of individuals at different levels of development and for varying purposes. A basic mode of approach may be to involve students in a genuine group counseling experience in order to understand the phenomenon of group experience. *Prep.: CRS 3503 Counseling Theory and Process.*

CRS 3508 The College Student and the Campus

The relationship between college students' behavior and their environment is examined, with focus on students' rights, their social-emotional developmental concerns, and their search for identity. The impact of societal forces and nontraditional patterns of learning on college curriculum options is examined, and varying concerns of personnel services in different types of college climates, including the community college, are discussed. Current issues in higher education are examined as they relate to services offered to students.

CRS 3517 Consultation Seminar

Offers a review of various consultation models, including behavioral consultation, process consultation, and systems consultation. Study also examines current research in the field of consulting consultation. Particular emphasis is placed on the development of a personal consultation style and enhancement of consultation skills.

CRS 3518 Career Counseling Seminar

Study focuses on three types of counseling experiences: career-education program planning, leadership of career-development groups, and vocational counseling. Learning activities include case studies and audiotapes of career counseling sessions, class discussions of local problems and their solutions, didactic instruction, and the implementation of an actual career-education program relative to the student's area of interest.

CRS 3525 Family and Parent Counseling

The focus of this course is on a conceptual understanding of family systems theory and its application to and implications for family counseling. Structural, communicative, and strategic approaches to marital, parent, and family counseling are presented as the family is studied as an interactional system, as a seedbed of distress and health. Students have the opportunity to become familiar with family assessment, counseling skills, and strategies. *Prep.: CRS 3503 Counseling Theory and Process.*

CRS 3526 Seminar in Student Personnel Work

Relevant topics and cases for personnel workers and administrators in higher education will be discussed and studied in depth. Particular emphasis is placed upon the development of student personnel programs, budget planning and development, and staff relationships. The expertise of appropriate specialists is utilized.

CRS 3527 Counseling Strategies for Children and Adolescents

Intended primarily for students who will counsel in school settings or other settings emphasizing work with children and adolescents. A broad range of approaches will be considered, including, but not limited to, behavior modification, Gestalt, and Adlerian strategies. Special emphasis will be placed on the development of strategies designed to help alleviate typical school-related and developmental problems such as nonachievement, decision making, negative self-identity, and disruptive behavior. Consideration will also be given to the counselor's role as a consultant to teachers, parents, and administrators in effecting positive behavior change. *Prep.: CRS 3503 Counseling Theory and Process.*

CRS 3528 Vocational Counseling Strategies

The individual's role expectations in the world of work will be examined from a human development perspective, and a systematic program to foster self-awareness will be set forth. Vocational counseling is viewed as dealing with the entire individual, including his or her values, underlying psychological needs and drives, and the influence of the environment on his or her level of development and career awareness. Other topics to be developed in this course will include counseling with females and nonachievers, the decline of the work ethic, community resource development, job placement, and information giving as a perceptual process. The course is intended for a variety of client populations from adolescence through adulthood. *Prep.: CRS 3503 Counseling Theory and Process.*

CRS 3529 Rehabilitation Counseling Strategies

Primary emphasis will be on the roles and functions of the rehabilitation counselor, relevant issues in the field, and an overview of the rehabilitation process. Special problems and techniques of counseling with the disabled (physical, mental, and behavioral disorders) will be examined through case studies and role playing. Discussion will also cover disability in the context of social deviance and psychosocial approaches to understanding human behavior, including self-concept, social role theories, and rational-behavioral approaches. *Prep.: CRS 3503 Counseling Theory and Process. (This prerequisite is waived for Rehabilitation Administration majors.)*

CRS 3530 Psychological Counseling Strategies

Focuses on a variety of strategies designed to alleviate problems of older adolescents and adults. Developmental and perceptual Gestalt insight approaches and behavioral approaches to counseling will be analyzed for their effectiveness with a variety of psychological problems. This course is primarily intended for the student working with client populations in mental health settings and college counseling centers. *Prep.: CRS 3503 Counseling Theory and Process.*

CRS 3531 Case Studies In Marriage and Family Counseling

An advanced-level course for students with previous experience or preparation in marriage and family counseling. Skills to be emphasized may include 1) the preparation of case studies of family and marriage histories and current functioning; 2) the design of service, counseling, and referral programs based upon comprehensive studies of needs and resources; and 3) the practice of counseling strategies through role playing, taped interviews, and progress reports of current counseling activities. *Prep.: CRS 3525 Family and Parent Counseling.*

CRS 3532 Seminar in School Psychology

This course provides an intensive analysis of philosophical, technical, and school administrative issues contributing to the professional identity and consultative function of the psychologist in an educational milieu. Simulations, case studies, and research projects will be used to study these issues. *Prep.: Permission of instructor.*

CRS 3533 Psychoeducational Prescriptions

Recommended for all school counseling majors and required of all school psychology majors, this course will provide training and supervision in synthesizing data on a student's cognitive, affective, and interpersonal needs with educational plans which 1) are based directly on that data, 2) may be implemented in the school setting, and 3) meet the 766, PL 94-142 criteria for such plans. *Prep.: Permission of instructor.*

CRS 3534 Individual Intelligence Testing**(6 Q.H.)**

Preparation to administer, score, and interpret the Stanford-Binet Intelligence Test, the Wechsler Adult Intelligence Test, and the Wechsler Intelligence Scale for Children. Consideration will be given to the theories of intelligence upon which the tests are based and the use of the tests in educational and clinic settings. Students will be required to administer and score thirty tests, including some from each of the three tests included in the course. *Prep.: CRS 3501 Psychological Testing.*

CRS 3535 Seminar in Contemporary Issues in Counseling

Intensive study of a selected topic in counseling such as counseling minorities, current research, sex counseling, transactional analysis theory and practice, and behavioral counseling. Course objectives will vary according to the topic but may include a review of the literature, skill building workshop, and action projects. *Prep.: CRS 3538 Advanced Theories of Behavior Change and/or permission of instructor.*

CRS 3536 Advanced Group Counseling

This course will be a continuation of the content presented in Group Counseling, placing greater emphasis on developing skill in conducting group counseling at a variety of age levels. Greater attention will be given to relevant readings and research on group process and methods for behavior modification. *Prep.: CRS 3507 Group Counseling.*

CRS 3537 Seminar in Counseling Supervision and In-Service Education

Theory and practice of the supervisory process as it applies to the evaluation of counselor effectiveness and professional development. Theory readings, discussions, role playing, and a written plan for in-service staff development are course requirements, but the major activity of the course involves the use of audio and videotapes of actual supervisory sessions conducted by class members. *Prep.: Master's degree in guidance or permission of the instructor.*

CRS 3538 Advanced Theories of Behavior Change I

An advanced-level counseling course required of all CAGS students and designed to provide greater depth of cognitive understanding of three major approaches to therapeutic practice, i.e., the behavioral, depth psychological, and general systems viewpoints. Original readings from selected principal theorists will be required. The course will compare assumptions, goals, and strategies of the theorists studied in order to build a strong conceptual basis for a counseling eclecticism from these analyses. Some of the theorists studied may include Skinner, Wolpe, Bandura, von Bertalanffy, Adler, Jung, and Rank. *Prep.: At least two counseling courses emphasizing both theory and process.*

CRS 3540 Advanced Psychodiagnostics

This is an advanced-level course providing intensive supervision in the clinical assessment of ego functioning in children and adolescents. A rudimentary knowledge of the theory and practice of psychodagnosis is assumed. This course will enable students to receive supervision on clinical evaluations on which they are working. A heavy emphasis will be placed on integrating data from a variety of sources and making in-depth interpretations and appropriate recommendations. *Prep.: CRS 3839 Psychodiagnosis with Children and Adolescents.*

CRS 3541 Psychodiagnostic Measures

This is an advanced-level course in the clinical assessment of adults. The course places heavy emphasis on differential diagnosis and personality description using data from a variety of sources—interviewing, case histories, and objective and projective testing. Some of the tests typically studied in this course may include the California Psychological Inventory, Minnesota Multiphasic Personality Inventory, Bender-Gestalt and Sentence Completion Tests, Wechsler Adult Intelligence Scale, and Draw-A-Person Test. Students will be required to administer and interpret psychological test data and to report their findings in a psychological report. *Prep.: CRS 3501 Psychological Testing.*

CRS 3542, 3510 Advanced Fieldwork (8 Q.H.)

Required of all CAGS students. Students may be assigned a fieldwork placement consistent with their major professional goals and/or the settings in which they intend to work. The activity of the fieldwork may extend across the academic year from September to June and require a minimum of one and a half days per week, or the equivalent, in the fieldwork setting. Seminars will meet, subject to change, on alternate weeks with additional individual supervision on campus. Supervision will also be provided in the field setting. Both quarters must be completed before credit will be given for the course. *Prep.: Counseling Practicum or the equivalent in experience.*

CRS 3803 Institute in Counselor Education

(See general institute description on page 77.)

CRS 3806 Workshop in Counselor Education

(See general workshop description on page 77.)

CRS 3839 Psychodiagnosis with Children and Adolescents

This is an advanced-level course in the theory and practice of ego functioning in children and adolescents. Heavy emphasis is placed on the case-study method. A major goal of the course will be to conduct a psychological assessment and report the findings of this assessment in terms of cognitive, perceptual-motor, affective, cognitive, and social functioning. Students will become familiar with several methods of gathering assessment data. *Prep.: CRS 3501 Psychological Testing and CRS 3534 Individual Intelligence Testing.*

Speech-Language Pathology and Audiology

SLA 3600 Neurological Bases of Communication

This course will provide the student the opportunity to acquire a basic understanding of neuroanatomy and neurophysiology as they relate to normal aspects of speech, hearing, and language.

SLA 3601 Advanced Study in Articulation Disorders

An exploration into advanced theories of normal and abnormal phonological development with emphasis on distinctive theory and on phonetic theories of speech production; direct application of theories to diagnosis and treatment of various phonological disorders. *Prep.: Undergraduate course in articulation disorders and permission of instructor.*

SLA 3602 Differential Diagnosis in Speech and Language Pathology

This course is designed to offer students the opportunity to learn formal and informal test procedures. *Prep.: SLA 3603 Test Procedures in Speech and Language or permission of instructor.*

SLA 3603 Test Procedures in Speech and Language Pathology

The course is designed to offer students the opportunity to develop competence in administering and interpreting a variety of tests used in diagnosing communication disorders. Information relative to the case history and interview, as well as to formal test procedures and report writing, will be included. *Prep.: Permission of instructor.*

SLA 3604 Language Disturbances in Children

This course will emphasize current theories in language behavior and their practical application to the assessment and remediation of language disturbances in children. Lectures, discussions, and case presentations may focus on the following issues: what constitutes a language problem, what assessment tools and therapeutic techniques are currently available, and what underlying principles are involved in selecting and organizing the content of a remediation program. *Prep.: SLA 3602 Differential Diagnosis in Speech and Language Pathology, SLA 3603 Test Procedures in Speech and Language Pathology, or permission of instructor.*

SLA 3605 Aphasia Rehabilitation

Emphasis on current attitudes toward therapy and new methods, clinical methods of evaluation which are preparatory to therapy, and observation of therapeutic methods. *Prep.: SLA 3600 Neurological Bases of Communication and permission of instructor.*

SLA 3606 Clinical Management In Stuttering

This course will emphasize diagnostic techniques, a review of the current therapeutic approaches, consideration of the individual's need in therapy,

and the process of behavioral and attitudinal change from within a psychodynamic framework. Also to be considered are termination, referral, and group therapy. *Prep.: Permission of instructor.*

SLA 3607 Seminar: Speech Science

Study focuses on current physiological, acoustical, and perceptual data used to describe both normal and disordered speaking populations. Research techniques and instrumentation in the field of speech science are also examined. The application of theoretical information from speech science to the diagnosis and treatment of communicative disorders is discussed. *Prep.: SLA 3875 and SLA 3876 Advanced Clinical Practice I and II.*

SLA 3608 Seminar: Voice Disorders

Etiology, symptomatology, and disorder complexes related to phonation. Special emphasis is placed on the philosophy and methods used in the assessment and treatment of voice disorders. *Prep.: SLA 3602 Differential Diagnosis in Speech and Language Pathology and SLA 3603, Test Procedures in Speech and Language Pathology.*

SLA 3620 Clinical Audiometry I

The use of pure tone and speech reception instrumentation in hearing evaluation; the interpretation of results in the diagnosis of functional and organic disorders. Lectures, demonstrations, observations, and practicum. *Prep.: Introduction to Audiology and consent of instructor.*

SLA 3621 Medical Perspective to Anatomical Correlates in Audiology

This course provides the student with the opportunity for hands-on experience with dissection of human temporal bones as an approach to learning temporal bone anatomy; physiology and neurology are stressed. Students may become familiar with dissection techniques, use of dissecting microscope, and will be required to observe actual surgical procedures in a hospital. *Prep.: Permission of department chairperson.*

SLA 3622 Pathologies of the Ear

Lectures and observations in the organic and neurological pathologies of the ear, e.g., otitis media, Meniere's disease, and otosclerosis. Consideration of approaches to treatment (medical setting). *Prep.: Permission of instructor.*

SLA 3623 Clinical Audiometry II

Specialized techniques (Bekesy, EEG, site of lesion battery, BSR, ENG); the results and interpretation in the diagnosis of functional and organic hearing disorders. Lectures, demonstrations, and observations. *Prep.: Introduction to Audiology and Audiometry I and permission of instructor.*

SLA 3624 Institute in Speech Pathology and Audiology

(See general institute description on page 77.)

SLA 3624 Clinical Audiology

Physical characteristics of hearing aids and their performance. Theoretical approach to selection and fitting of hearing aids, and analysis of hearing aid dispensing systems. *Prep.: Introduction to Audiology and permission of instructor.*

SLA 3625 Psychosocial Aspects of Communication Disorders

This course is concerned with the psychological, educational, and social aspects of communication disorders, particularly auditory impairment. *Prep.: Permission of instructor.*

SLA 3626 Seminar in Audiology

Advanced study of the development of principles and theories associated with modern procedures and methods used in audiology. *Prep.: Permission of instructor.*

SLA 3628 Psychoacoustics

This course offers the student the opportunity to explore the relationship between acoustic stimuli and psychological responses to sounds. Particular emphasis is placed on the similarities and differences in the perception of normal hearing and among different types of impaired hearing. Major topics of study include a general review of the physics of sound, detection, discrimination, masking, binaural hearing, and speech perception. *Prep.: Permission of instructor.*

SLA 3629 Audiology for Speech-Language Pathologists

This course offers Speech-Language Pathology majors a review of standard procedures and an update of contemporary issues in audiology. Study focuses on pathological disruption of the auditory system and on assessment procedures currently applied and their relationship to patient management and treatment plans.

SLA 3640 Cerebral Palsy

Neuromuscular involvements and concomitant language and speech disorders; intellectual deficits, psychological aspects, communicative disorders of a cerebral palsied population; testing, placement, and management of the cerebral palsied child with emphasis on a multidisciplinary approach. *Prep.: Permission of instructor.*

SLA 3641 Physiological Acoustics

Particular emphasis is placed on the biophysics of the hearing mechanism, especially in terms of actual clinical utility. Comparative anatomy and physiological analysis are stressed. *Prep.: Introductory courses in Speech and Hearing, and permission of instructor.*

SLA 3642 Seminar: Orofacial Anomalies

Etiology, symptomatology, and problems associated with orofacial anomalies. Emphasis will be

placed on the speech, language, and hearing characteristics and the assessment and treatment of persons with orofacial anomalies. Psychological and social considerations and an analysis of the team habilitative effort will be presented.

SLA 3643 Seminar in Speech Pathology

Individual research and/or critical review of the literature in some area of basic science, speech sound learning, language, voice, fluency, or multiple disorders, with special emphasis on the impact of deafness on psychosocial development. Class presentation of material and class discussion may be included. *Prep.: Open to graduate students who have completed the equivalent of two quarters of graduate work in Speech Pathology and have the instructor's permission.*

SLA 3645 Neuropathology

Application of functional neuroanatomy in comprehending the various disease processes involving the nervous system; cerebrovascular disease tumors or malformations, Parkinson's disease, multiple sclerosis, and others. *Prep.: Permission of instructor.*

SLA 3647 Hearing Science Seminar

Individual research and/or critical review of the literature in the area of bone conduction of auditory signals, evoked response and audiometry, impedance and audiometry, cortical processing of auditory input, and other related topics. Students will be responsible for class presentations of researched material. *Prep.: Permission of instructor.*

SLA 3650 Medical Perspective to Anatomical Correlates in Speech Pathology

This course will provide the opportunity for hands-on experience with dissection of human larynxes as an approach to learning voice tract anatomy. Students may become familiar with dissection techniques, use of dissecting microscope, and may have an opportunity to observe actual surgical procedures in a hospital. *Prep.: Permission of department chairperson.*

SLA 3651 Social Dialectology: Theoretical and Educational

This course focuses on the social and cultural influences on the language behavior and communication needs of the culturally "different" child. It emphasizes the interrelationship between linguistic structure and social structure and its implications for clinical intervention. *Prep.: Permission of instructor.*

SLA 3652 Behavior Modification: Operant Procedures in Speech and Language Training

This course reviews principles and procedures of the functional analysis of behavior and focuses upon the application of behavioral theory and research to speech, language, and hearing training. It emphasizes clinical investigation in the experimental analysis of behavior of communication

disorders and experiences in the application of experimental procedures in assessment and treatment programs. *Prep.: Permission of instructor.*

SLA 3653 Seminar: Communication Disorders

This course provides an exploration into the development of communication and communication disorders, with focus on early conversational interaction, children's discourse, and pragmatic intents. Emphasis is placed on deficient social bases and their effect on language performance as well as trends for clinical procedures and intervention strategies for language-disordered children. Communication is viewed as the ultimate goal of therapy. Course participants are expected to complete a research project on the development of communication and child discourse and its application to clinical assessment and intervention.

SLA 3698 Workshop in Speech Pathology and Audiology

(See general workshop description on page 77.)

SLA 3800 Directed Study

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the department. Not available to special students. *Prep.: Approval of the chairperson of the department and of the director of the graduate school. (Approval forms must be submitted during the quarter prior to registration of the Directed Study.)*

SLA 3801 Thesis

A research activity that may be selected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

SLA 3875 Advanced Clinical Practice I (2 Q.H.)

A two-quarter sequence of supervised clinical experience in speech pathology and audiology designed for beginning graduate students. Practicum sites include the Northeastern University Hearing, Language, and Speech Clinic; satellite clinics; and/or educational settings. Students must be available a minimum of two days per week during the academic year. This course also requires attendance at on-campus seminar meetings held twice a month. *Prep.: Permission of clinical staff.*

SLA 3876 Advanced Clinical Practice II

(3 Q.H.)

A two-quarter sequence of supervised clinical practicum in speech pathology and audiology at the Northeastern University Hearing, Language, and Speech Clinic; medical settings; educational settings; and rehabilitation centers. Practicum experience emphasizes advanced diagnostic and management techniques stressing the application of theory to practice. Students must be available a minimum of two days per week during the academic year. *Prep.: SLA 3875 Advanced Clinical Practice I and permission of clinical staff.*

SLA 3877 Advanced Clinical Practice III

(3 Q.H.)

A two-quarter sequence of supervised clinical practicum in speech pathology and audiology designed for advanced graduate students. Practicum experience emphasizes problem-solving techniques relevant to case management. Students must be available a minimum of two days per week during the academic year. *Prep.: SLA 3876 Advanced Clinical Practice II and permission of clinical staff.*

Rehabilitation and Special Education

Rehabilitation Administration and Counseling

CRS 3437 Community Planning in Rehabilitation

What administrators need to know about community planning to develop programs in their areas. Basic principles of community planning, organization, and dynamics, as well as interdisciplinary relations in rehabilitation. Examples of community planning from different rehabilitation agencies and the referral process among these agencies will be studied.

CRS 3438 Federal-State Relations in Rehabilitation

The complex network of federal-state relations and their implications for rehabilitation. Grant procedures, matching formulas, public relations and

RSA directives, state and federal legislation pertinent to rehabilitation.

CRS 3439 Social Welfare and Rehabilitation

This course attempts to acquaint administrators, counselors, and other human services personnel with the broad field of social welfare. The course reviews the historical background of the relationship between vocational rehabilitation and social welfare and the more recent developments in the relationship of these fields.

CRS 3440 Program Evaluation in Rehabilitation

The emphasis in this course will be on administrative research, program evaluation, grantsmanship, etc. In addition, students will have the opportunity to develop a research design on some aspect of rehabilitation administration and carry out the necessary research operations involved.

CRS 3442 Fiscal Policy and Management I

An introduction to the concept of fiscal and managerial control. Areas to be covered may include accounting and budgetary procedures, need surveys, goal-setting practices, recruitment, staffing, training, professional development, caseload management, program planning, utilization of research, leadership patterns, performance appraisal, and external relationships. Case method approach may be used in classroom exercises.

CRS 3443 Administration of a Sheltered Workshop

Special problems of administering a sheltered workshop, such as community planning, work evaluation, job training, labor relations, contracting, production, and occupational placement.

CRS 3477 Evaluation of Deaf Rehabilitation Clients

Methods and techniques of psychological and vocational evaluation for deaf rehabilitation clients, including evaluation of client biographical characteristics, evaluation interview, and psychometric assessment. Required of all students in Deafness specialization of Rehabilitation Counseling program. *Prep.: CRS 3501 Tests and Test Procedures and SLA 3644 Foundations of Deaf Education.*

CRS 3449 Psychological Problems of Disability

An advanced course in psychopathology as it relates to the impact of disability on personality. In-depth study of the moderately and severely handicapped from the viewpoint of psychosocial factors, interpersonal relationships, and cognitive versus noncognitive functioning in those with motor and sensory disabilities, problems of dependency and motivation; role of psychosomatic factors. Some discussion of the role of treatment and rehabilitation.

CRS 3454 Rehabilitation of the Geriatric

This course presents a comprehensive treatment of the problems, dimensions, and parameters involved in the administration of the various services and facilities for the rehabilitation of the geriatric. Special emphasis is on the philosophy of rehabilitation versus disengagement.

CRS 3455 Critical Issues in Rehabilitation Administration

This course is built around the exploration and in-depth discussion of current issues which are highly problematical to the field. Among these issues are the breadth of the concept of disability, appropriate training sequences for the various rehabilitation disciplines, resolution of conflict over role overlap among disciplines, appropriate models for service delivery systems. The most current and relevant research may be brought to bear upon these areas, as well as knowledge from the reservoir of experience of instructors, visiting experts, and the student participants themselves.

Students will be exposed to the issues as they exist in the profession and in the community. A theoretically oriented frame of reference will be brought to bear upon problems when feasible.

CRS 3801 Thesis

A research activity that may be selected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

CRS 3809 Doctoral Dissertation

Prep.: Admission to candidacy in the Doctor of Education degree program.

CRS 3804 Institute in Rehabilitation Administration

(See general institute description on page 77.)

CRS 3807 Workshop in Rehabilitation Administration

(See general workshop description on page 77.)

CRS 3800 Directed Study

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the department. *Not available to special students. Prep.: Approval of the chairperson of the department and of the director of the graduate school. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

CRS 3433 Introduction to Rehabilitation

An overview of and orientation to the field of rehabilitation, including its historical development, legislative involvement, psychological implications, and sociological dimensions. Emphasis is placed on coordinating and integrating services as they relate to the field of rehabilitation as a community process.

CRS 3434 Principles of Medical Rehabilitation

The wide spectrum of disabilities that could profit from rehabilitation, including orthopedic, neurological, medical, surgical, and mental disabilities. The course may also present basic principles of medical rehabilitation that administrators should know. Psychological aspects of disability also discussed.

CRS 3435 Program Development in Rehabilitation

This course deals with the use of the rehabilitation model in program development for the physically handicapped, mentally retarded, emotionally disturbed, aging, welfare populations, youthful offenders, culturally disadvantaged, and other special community groups. Emphasizes the administrative involvement in developing and supporting the diagnostic, evaluative, counseling, and placement procedures used in such rehabilitative programs. Issues involving clinical program planning may be explored.

CRS 3436 Organization and Administrative Theory

The body of conceptual knowledge regarding organizational and administrative theory will be examined. Formal and informal organizations, organizations as social systems, status and role concepts, leadership in organizations, power structure, relationships to authority, decision making, and communication in and between organizations. An organizational analysis will be made of all the different types of rehabilitation settings currently in use.

CRS 3441 Practicum in Rehabilitation (8 Q.H.)

Students are usually assigned to a variety of rehabilitation agencies for their practicum experience. Problem solving relevant to experiences encountered in internship. A seminar may be regularly conducted by a senior faculty member in conjunction with the practicum experience. This seminar offers students an opportunity to share their fieldwork experiences and resolve problems in rehabilitation which are connected with their field placements. (Two sections of this practicum are offered—one for those majoring in Rehabilitation Administration and one for those majoring in Rehabilitation Counseling.)

CRS 3444 Fiscal Policy and Management II

Understanding the fiscal management of the typical rehabilitation setting, including basic rehabilitation agency accounting, planned program budgeting, disbursements, cost analysis, contracting, taxation, forecasting, and funding. The implication of data processing for fiscal management is covered in the course. Special problems will be assigned during the course.

CRS 3445 Legal Aspects of Rehabilitation and Special Education

This course is designed to sensitize rehabilitation administrators, special educators, rehabilitation counselors, and other personnel to the impact of legislative developments upon the field of rehabilitation and special education. Special emphasis is placed on understanding the legal implications for rehabilitation of the latest Vocational Rehabilitation Administrative Amendments, workmen's compensation laws, eligibility determination criteria, and Social Security Amendments. Latest federal and state special education legislation is covered.

CRS 3446 Occupational Placement

A study of the dynamics of moving the rehabilitation client into the world of work within the framework of the specific community structure. Development of facility in use of resource materials in occupational information, job description and analysis, performance appraisal, training, and vocational assessment. The personnel point of view of the handicapped individual is discussed and analyzed, and more effective placement practices developed.

CRS 3448 CAGS Rehabilitation Practicum

Students are usually assigned to rehabilitation agencies, where they are expected to spend 250 clock hours under appropriate supervision. A seminar with regular faculty members is conducted twice each quarter.

CRS 3450 Administrative Problems in Rehabilitation

Seminar designed to analyze, in depth, critical issues and selected rehabilitation problems. Operations and systems research as applied to rehabilitation will be highlighted. Students are offered the use of institute research studies and studies available through social and rehabilitation services, completed research, and demonstrative projects.

CRS 3451 Essentials of Case Management and Supervision

The relationship between case management and casework supervision. Topics are the dynamics of the communication process, decision making, conflict, resolution and compliance, management of resources external to the organization, structural and functional analysis of supervisory process, and caseload management.

CRS 3452 Rehabilitation of the Alcoholic and Drug Dependent

A study of comprehensive factors, including the nature of etiology dynamics involved in alcohol and drug dependency; techniques for evaluation; rehabilitation administration, planning, and treatment.

CRS 3453 Rehabilitation of the Penal offender

The rehabilitation of the penal offender is examined from an eclectic point of view. Psychodynamic elements are stressed, as well as social factors in the etiology, evaluation, and treatment and rehabilitation seminar planning and administration.

Special Education**CRS 3429 Development and Implementation of Programs for the Severely Handicapped**

Course work includes observation of severely handicapped persons in the classroom and community; demonstration of evaluation and assessment techniques; and analysis of developmental, educational, and rehabilitation plans for severely handicapped persons. *Prep.: CRS 3412 Psychology of Individuals with Special Needs.*

CRS 3428 The Severely Handicapped

A review of handicapping conditions and consideration of the implications of severe multiple handicaps. Students will develop a case study of a severely handicapped person in conjunction with a review of relevant literature. *Prep.: Permission of the instructor.*

CRS 3801 Thesis

A research activity that may be selected by the student in lieu of two courses (8 quarter hours), with the approval and recommendation of the adviser.

CRS 3805 Institute in Special Education

(See general institute description on page 77.)

CRS 3808 Workshop in Special Education

(See general workshop description on page 77.)

CRS 3400 Alternatives for Mainstreaming Individuals with Special Needs

This course is for administrators, teachers, and specialists who are involved with mainstreaming individuals with special needs. Alternatives in decision making and program development, implementation, and evaluation may be explored with members of various disciplines who provide services for special needs children.

CRS 3401 Educating Individuals with Learning Disabilities

This course surveys behavioral and social-emotional characteristics of individuals who manifest specific defects in perceptual, integrative, or expressive processes that impair learning. Current service delivery programs, individual learning styles, and related curriculum materials for elementary through high school-aged, learning-disabled students are also analyzed.

CRS 3404 Education of Individuals with Behavioral Disorders

A study of the various theories, programs, and approaches dealing with emotional disturbance. Emphasis on the role of the educator as it relates to the therapeutic management of individuals and groups displaying problems in socio-emotional development. Parent-teacher interaction is also discussed.

CRS 3405 Group Dynamics

Emphasis on understanding group growth, behavior, and action fundamental to developing solutions to the complex developing of group life. Students are given the opportunity to learn to examine their strengths and weaknesses, to examine group leadership styles, to become alert to new ideas and actions, to discover the pulse of a group, and to analyze reasons for one group's productivity and another's nonproductivity.

CRS 3406 Mental Health

Study of conditions leading to optimal social adjustment. Consideration of the relationship between the maturation process and mental health,

possible predeterminants of maladjustment, and factors which encourage the attainment of emotional maturity. Special emphasis is on the role of the school. Contributions from the fields of psychiatry, psychology, sociology, physiology, and medicine may be synthesized and evaluated.

CRS 3407 Case Conferences: Individuals with Special Needs

This course is conducted as a seminar in connection with the student's practicum. Case presentations by outstanding resource persons are thoroughly examined and discussed. Students will also be expected to make their own case presentations to the seminar. *Prep.: ED 3306 Abnormal Psychology and CRS 3404 Education of Individuals with Behavior Disorders.*

CRS 3408 Socio- and Psychodynamics of Family Life

Consideration is given to the internal and external dynamics of family life and the significance of such dynamics to the mental health of handicapped individuals and their families. Emphasis is on the impact of disability on family functioning and integration. Approaches to working with parents of special needs groups may be explored from psychodynamic, social learning, and systems viewpoints.

CRS 3409 Seminar: Problems of the Behaviorally Disordered

This course provides an intensive study of the special problems of the behaviorally disordered child. It gives seminar students the opportunity to proceed in depth in areas of special interest. Special attention focuses on problems presented by the autistic child, the neurotic child, the child with character disorders, the child with psychosomatic disorders, and the multihandicapped child. *Prep.: CRS 3424-CRS 3425 Etiology and Development of Special Needs.*

CRS 3410 Review of Current Methodology and Research in Learning Disorders

This advanced course is designed to help develop the following competencies in relation to educating learning-disordered individuals (early childhood through adulthood): use of task analysis and learning style to develop comprehensive individual education plans (refinement of skills developed in CRS 3409); use of current research to evaluate techniques of intervention (e.g., behavior modification and drug therapy for hyperactive children); review of current research to evaluate assessment techniques (e.g., effectiveness of available tests for learning disorders; ability to administer, score, and interpret tests useful in identifying learning disabilities); use of prescriptive techniques and materials for learning disabilities). Selection of topics within competency areas may be individualized for students, based on previous course work and experience. *Prep.: CRS*

3401 Educating Individuals with Learning Disorders and ED 3342 Research Design in Education.

CRS 3411 Development and Implementation of Programs for Learning Disorders

This advanced course helps to develop required skills for resource room and diagnostic-prescriptive teachers and special needs consultants to the regular classroom. Projects for the course include needs assessment for various special needs programs, development of a screening and diagnostic test battery, development of a diagnostic-prescriptive procedure for a specific population, development of in-service programs, development of a plan for educational group management. Projects may be selected by students according to their particular needs. Students in this course should be experienced in working with individuals with special needs. *Prep.: CRS 3401 Educating Individuals with Learning Disorders and CRS 3415 Assessment in Special Education, and CRS 3416 Diagnostic-Prescriptive Teaching.*

CRS 3412 Psychology of Individuals with Special Needs

A study of the social and emotional adjustment of the handicapped and of the psychological significance of mental, sensory, and motor variations. The effects of limitations imposed by attitudes of society, the attitudes of individuals toward their handicaps, and the effect of the handicap itself are evaluated. Implications for educational programs are analyzed. (This course should be among the first taken in the Special Education sequence.)

CRS 3413 Evaluation and Education of the Vocationally Handicapped

Designed to develop fundamental skills in the evaluation and teaching of activities related to the vocational development of disabled individuals. Work sample and other techniques are used to assess levels of skills. Focus is on activities such as home management, use of tools, household repairs, basic sewing, essentials of food preparation, and activities of daily living (ADL). Visits may be made to sheltered workshops and vocational adjustment centers.

CRS 3414 Rehabilitation and the Special Education Teacher

This course is designed to deal with effective working relationships between rehabilitation professionals and special education teachers. Elementary and secondary school personnel concerned with children with special needs will also find the course pertinent. Consideration is given to current legislation (Massachusetts Chapter 766) and its implementation, the teacher's role in rehabilitation, understanding of the total rehabilitation process, and rehabilitation resources available to school personnel.

CRS 3415 Assessment in Special Education

This field-based course offers students the opportunity to learn to administer selected norm-referenced tests for special needs populations, determine which tests will yield the most information in a variety of case studies, and interpret data obtained from a minimum of four norm-referenced test batteries.

CRS 3416 Diagnostic Prescriptive Teaching

Course instruction in this field-based course focuses on the following broad areas: development and implementation of individualized educational plans, including task analysis, annual goals, and short-range objectives; educational strategies and their application in classroom management; adaptation and selection of materials and strategies in various academic areas; perceptual-motor skills; and social-emotional interventions.

CRS 3417 Early Childhood Learning Problems: Identification and Program Development

Informal and formal screening and assessment procedures suitable for an early childhood population are evaluated. Students will be required to work with young children in order to acquire experience with screening and assessment techniques. The resulting information may then be used to develop programs to meet the needs of individual children. *Prep.: CRS 3415 Assessment in Special Education.*

CRS 3418 Special Education for Gifted Children

Identification, characteristics, and problems of gifted, creative, and talented children and youth. Emphasis on administrative and instructional adjustments needed to provide for this group of exceptional children.

CRS 3419 Fieldwork and Seminar with Special Needs Children

CRS 3420 Student Teaching and Seminar with Special Needs Children (4 Q.H. each)

The courses are scheduled to extend over a full year in a series of experiences as observer, tutor, and teacher. Students must make available approximately 250 hours or two days per week for two quarters for fieldwork, then approximately another 250 hours or four days per week for one quarter for student teaching. Students who are employed and who cannot devote full days to satisfy these requirements must arrange to be available evenings, weekends, and summers. Provision for attendance at biweekly seminars must also be made. Seminars are for the purpose of discussing with other students and professors the relevant issues confronted by teachers of special needs children. Outside speakers and programs may be arranged to extend this dialogue. The adviser's written approval will be required before the student can do field placement or student teaching. The adviser's written approval is also

required before students can obtain a waiver of student teaching.

All students, regardless of past experience, certifications, or letters of approval, are expected to do approximately 250 hours of fieldwork, set up and supervised by the University.

CRS 3421 Fieldwork and Seminar

CRS 3422 Practicum in Special Education (4 Q.H. each)

The practicum is designed to satisfy department requirements for field experience and extended practicum for SECP or other students who do not need certification. It extends over a full year and covers a series of experiences. Students must make available a minimum of two days per week for the first two quarters and five full days per week for the third quarter. Application for field placement is made two quarters prior to that for which fieldwork is planned. Part-time students who are employed will need to make provision for a full quarter of fieldwork, five days per week, and for evening, weekend, or summer assignments to satisfy the requirement for field experience. Provision for attendance at seminars must also be made.

CRS 3424, 3425 Etiology and Development of Special Needs (8 Q.H.)

The first quarter (CRS 3424) concentrates on factors which primarily affect deviations in cognitive, motoric, and physical development. Understanding of these factors will be used to discuss multidisciplinary life-management issues relating to Down's Syndrome, cerebral palsy, and other common conditions.

The second quarter (CRS 3425) concentrates on factors which primarily affect emotional development. Psychobiological, psychodynamic, and learning theory approaches may be discussed and

related to problems of lifespan management. Community programs in addition to the more traditional intervention techniques are analyzed.

CRS 3426 Seminar in Mental Retardation

A study of research in the field and its implications for teaching. Intervention strategies are studied and evaluated.

CRS 3427 Seminar: Neuropsychology of Learning and Behavior Disorders

Through critical review of the literature, varied neuropsychological interpretations of the nature of learning and behavior disorders are analyzed and discussed. Topics related to the function of the brain and its relationship to behavior include biochemical and physiological correlates, cognitive and perceptual factors, genetic and maturational variables, hemispheric specialization, and implications of drug studies. Implications of the above for educating and serving special needs individuals are useful to administrators, teachers, counselors, reading specialists, school psychologists, and those in allied health fields. Students will be expected to give a presentation in an area of interest related to the seminar topic. *Prep.: CRS 3401 Educating Individuals with Learning Disorders, CRS 3424 Etiology and Development of Special Needs, SLA 3604 Language Disturbances in Children, and/or permission of instructor.*

CRS 3800 Directed Study

This experience is provided for the student whose unique academic needs or interests cannot be adequately satisfied in any of the scheduled courses of the department. Not available to special students. *Prep.: Approval of the chairperson of the department and of the director of the graduate school. (Approval forms must be submitted during the quarter prior to registration for the Directed Study.)*

Physical Education

HSL 3500 Health Issues: Implications for Education

An analysis of selected major health issues in health education. Emphasis is on the importance of current research findings to health education programs in a variety of settings.

HSL 3501 School Health Education Curriculum

A study of selected curricula for school health programs, emphasizing the organization of curriculum components into an effective approach to health promotion and disease prevention in the school setting. An attempt is made to relate course activities to the needs of Massachusetts schools.

HSL 3502 Educational Strategies in Health Education

An analysis of contemporary educational techniques, concepts, and approaches of importance to the health educator in a school, community health agency, or medical setting. The use of educational diagnosis in determining appropriate educational strategies is emphasized as the major means of preventing health problems and improving health status. Health behavior models are presented as a basis for educational diagnosis.

HSL 3503 Contemporary World Health

A survey of the state of the world's health, the progress which has been made in improving global health status, and the difficulties yet to be overcome. The importance of "partners in health," as opposed to the solitary research worker, in reaching the current health needs is emphasized. Study includes an examination of the contributions of WHO, UNESCO, UNICEF, and FAO.

HSL 3504 Environmental Health

A review of the regional, national, and international status of the environment and its impact upon individual and community health. Major focus is on developing an understanding of the etiology of environmental problems such as overpopulation, pollution of air and water, radiation exposure, noise, and waste disposal.

HSL 3505 Consumer Health

Analysis and evaluation of the concepts involved in the careful selection of health products and services. Areas for student exploration and study projects include decision making relative to the selection of health products and services, evaluating advertising, quackery, and protection against useless or dangerous products through consumer organizations.

HSL 3506 Nutrition

A study of dietary nutrients and their influence on the health status of individuals at various stages of the life cycle. *Prep.: Anatomy and Physiology or permission of instructor.*

HSL 3600 Administration of Physical Education and Athletics

Physical education and athletics discussed as an entity consistent with the current emphasis on unity, economy, and equal opportunity. Modern practices and principles of general administration applied to problems of staffing, scheduling, budgeting, collective bargaining, personnel welfare, program development, and public relations. All levels of education and the broad spectrum of programs common to physical education and athletics are considered.

HSL 3605 Problems In Contemporary Athletics for Men and Women

Current problems, practices, and national issues pertinent to the conduct of athletic competition. National, state, and conference organizations are studied.

HSL 3606 Applied Evaluation in Curriculum and Instruction

Application of current educational evaluation theory to concepts of instruction and curriculum development in physical education. Includes formative and summative measures applied to the improvement of instruction, assessment of process and product in the educational program, interaction analysis. *Prep.: HSL 3501 or HSL 3644.*

HSL 3608 Advances in Instructional Concepts

Current practices in, and a search for new approaches to instruction in physical education. Includes analysis of teaching and learning styles, available instructional technology, and the implementation of instructional designs in physical education classes.

HSL 3609 Physical Education for Students with Special Needs

Study of the movement problems and characteristics of special-needs populations. Assessment, planning, instruction, and evaluation practices recommended for work with special-needs students in physical education classes. *Prep.: Adapted Physical Education or permission of instructor.*

HSL 3610 Management of Adapted Movement Performance Programs

Analysis of legal, behavioral, and environmental concepts related to specialized physical education/motor development programs and investigation of national management systems. *Prep.: HSL 3609 or HSL 3442 or equivalent graduate course.*

HSL 3615 Anatomic Kinesiology

A study of the human musculoskeletal system and its relationship to human movement patterns. Electromyography is used in assessing muscle-movement relationships. Current electromyographic research and techniques are investigated. *Prep.: Kinesiology or permission of instructor.*

HSL 3616 Mechanical Analysis of Sport

Application of mechanics of motion to the analysis of human motion. Emphasis is placed on cinematography and film analysis procedures in teaching and research. *Prep.: HSL 3615 Anatomic Kinesiology or permission of instructor.*

HSL 3617 Physical Fitness Appraisal and Guidance

Physical fitness screening tests and procedures, developmental programs, fitness-producing activities, and current trends in testing and research. *Prep.: Exercise Physiology and Measurement and Evaluation or permission of instructor.*

HSL 3618 Exercise in Cardiovascular Health and Disease

Acute and chronic effects of exercise upon the cardiovascular, respiratory, metabolic, and muscular systems. Principles of human performance assessment and exercise prescription applied to adults in exercise-based prevention, intervention, and post-coronary programs. *Prep.: Exercise Physiology or Advanced Physiology.*

HSL 3619 Electrocardiography

A study of basic and intermediate electrocardiography, including cardiac function, lead systems, rate, rhythm, axis, infarction, ischemia, hypertrophy, effects of cardiovascular drugs, and purposes and principles of exercise testing. *Prep.: HSL 3618.*

HSL 3620 Laboratory in Exercise Testing and Prescription

Practicum in graded exercise testing, including determination of EKG, blood pressure, pulmonary, and metabolic response to exercise; pulmonary function testing; assessment of body composition; and tests of muscular strength, endurance, and flexibility; prescription of exercise for persons in cardiopulmonary prevention, intervention, and rehabilitation programs. Students are expected to do fieldwork as exercise technicians and leaders in prevention and/or rehabilitation programs. As part of the course requirements, each student must conduct a laboratory project. *Prep.: HSL 3618 and HSL 3607 (HSL 3607 may be taken concurrently).*

HSL 3625 Trauma Assessment and Treatment in Sport

An investigation of injury pathology, evaluative testing, diagnosis, and appropriate treatment modalities. *Prep.: Undergraduate Athletic Training or experience.*

HSL 3626 Reconditioning in Sports Injury

Rehabilitation procedures and techniques appropriate to the post-injury retraining of athletes. *Prep.: Adapted Physical Education or permission of instructor.*

HSL 3630 Perceptual-Motor Development

A survey of the development of movement control from birth to maturity. Changes in motor performance due to age, motor development expected at various stages, and the interrelations of such factors as growth, social context, cultural expectation, motor abilities, and sequential changes in motor control are examined.

HSL 3631 Movement and the Learning Process

An examination of the scientific method as applied to the learning and performance of motor skills. The course surveys a range of theoretical positions and includes laboratory experiences as well as the interpretation of motor-learning studies. Major variables affecting motor learning and performance are examined from several theoretical standpoints. *Prep.: HSL 3630 Perceptual-Motor Development or permission of instructor.*

HSL 3632 Early Childhood Motor Patterns

An examination of observational and experimental aspects of developmental motor learning. The sequential development of motor skills and various factors contributing to motor control development, as well as current issues in movement development, are studied. *Prep.: HSL 3631 Movement and the Learning Process or permission of instructor.*

HSL 3640 Comparative Physical Education

Both past and present philosophies and practices of national and international programs in physical education are compared. Historical analysis is introduced as a research technique.

HSL 3641 Philosophies in Physical Education and Sport

An exploration of major philosophies, past and present, and their influence on modern physical education and sport. Students are expected to delineate their personal philosophies, explore philosophical analysis as a research technique, and review philosophical research. *Prep.: Philosophy, Philosophy of Education, or permission of instructor.*

HSL 3642 Sociology of Sport

An analysis of the sociological principles and factors operative in the interaction between sport and society. Pertinent literature and research are reviewed. Topics of discussion include the pervasiveness of sport, social stratification, politics, economics, sport and the mass media, race, women, violence, competition, deviance, subcultures, and sport in the future. *Prep.: General Psychology or permission of instructor.*

HSL 3643 Psychology of Coaching and Sport

The psychodynamics of the athlete and the coach, with particular reference to personality, maturation, motivation, learning, emotions, and perception. Individualized projects are required. *Prep.: General Psychology or permission of instructor.*

HSL 3650 Planning and Developing Facilities for Physical Education and Recreation

The principles, terminology, and standards for planning, constructing, and using indoor and outdoor facilities for physical education and recreation. Integrated planning among all municipal departments is stressed.

HSL 3651 Supervision of Professional Personnel

A study of contemporary personnel management as applied to staff in physical education, physical therapy, and recreation and leisure services. Emphasis is on task analysis, personnel practices, leadership, and evaluative techniques.

HSL 3652 Critical Thinking and Evaluation in Physical Education and Recreation and Leisure Studies

Investigation of the acquisition of knowledge in two disciplines. Examination includes evaluating knowledge and practice through experiences in decision making, logical analysis, and critical thinking.

HSL 3898, 3899 Seminar/Workshop

Special seminars or workshops in physical education on topics of timely interest. Graduate credit may be granted for successful completion of a workshop, but credit may not be applied toward a degree program without the program adviser's approval. A maximum of eight quarter hours earned in seminars or workshops may be applied toward the degree.

Recreation and Leisure Studies

HSL 3822, 3823 Seminar/Workshop

Special seminars or workshops in recreation and leisure studies on topics of timely interest. Graduate credit may be granted for successful completion of a workshop, but credit may not be applied toward a degree program without the program adviser's approval. A maximum of eight quarter hours earned in seminars or workshops may be applied toward the degree.

HSL 3410 Contemporary Theories of Recreation and Leisure

An exploration of the various theories and philosophic concepts of recreation and leisure, as well as their relationship to, and implications for, work, play, recreation, and leisure in contemporary society. Survey of the sociocultural development and historical background of the recreation and park movement. *Required of all students in Recreation and Leisure Studies.*

HSL 3411 Program Evaluation in Recreation and Leisure Services

Focuses on comprehensive systems for evaluating program effectiveness as they relate to the consumer of recreation and leisure services. Major emphasis is placed on developing an evaluation system for an agency of the student's choice. Case studies are drawn from the public, nonprofit, and commercial sectors. *Required of all students in Recreation and Leisure Studies.*

HSL 3412 Seminar in Contemporary Issues and Problems in Recreation and Leisure Services

Discussion of national and international issues, current trends, and contemporary problems as they affect recreation services. *Required of all students in Recreation and Leisure Studies. Prep.: HSL 3410.*

HSL 3420 Grantsmanship

A seminar in which the student has the opportunity to develop a grant proposal for submission to a funding source chosen by the student. Government and foundation grant programs are explored.

HSL 3421 Budget Analysis

Capital and operating budgets are analyzed using such techniques as cost-effectiveness and benefit-cost analysis, forecasting, and present value analysis. The concepts of depreciation, direct and indirect costs, and service volume are studied as they relate to pricing decisions. Focus is on improving management decisions.

HSL 3422 Administration of Resident Camp Programs

An in-depth study of staffing, sanitation, and health; purchasing and storage of food, materials, equipment, and supplies; kitchen management; insurance, construction, and maintenance of buildings;

and program areas as they affect resident camping programs. A study of nationwide goals and trends in the camping movement is included.

HSL 3423 Advanced Organization and Administration of Recreation and Leisure Services

Patterns for the implementation of recreation and leisure services by school systems, voluntary agencies, national service organizations, municipal governments, and state and federal agencies investigated in depth.

HSL 3424 Programs in Recreation and Leisure Services

An examination and evaluation of program content, leadership, administration, and facilities in recreation and leisure services sponsored under public, private, religious, industrial, and voluntary auspices.

HSL 3425 Public Relations for Recreation and Leisure Service Agencies

The central purpose of public relations is to influence public opinion. This course focuses on practical and ethical aspects of public relations for recreation and leisure service agencies. Case studies are drawn from the public, nonprofit, and commercial sectors.

HSL 3426 Politics and Bureaucracy in Recreation and Leisure Services

Practical problems faced by recreation professionals in public service are investigated. Students study relationships between elected officials, bureaucrats, peers, subordinates, and supervisors in state and local governments.

HSL 3427 Recreation and the Community School: Concepts and Practices

The role of recreation studied as an integral part of programming for the community school. An analysis of the community school concept with regard to philosophy, physical plant requirements, personnel, finance, and community involvement.

HSL 3428 Leisure and Delinquent Behavior

Recreation studied as an intervention strategy to prevent and rehabilitate delinquent behavior.

HSL 3441 Seminar on Programming in Therapeutic Recreation

An overview of systems analysis and design techniques and their application. Emphasis is on therapeutic recreation planning at the administrative level. *Prep.: An undergraduate program planning course in therapeutic recreation.*

HSL 3442 Therapeutic Recreation Services for Individuals with Disabilities

An introduction to the nature and scope of therapeutic recreation, including a review of its history and recent advances in professionalization. The

role of service delivery in various settings and the major issues confronting this professional specialization are examined.

HSL 3443 Observations of Therapeutic Recreation in Treatment Settings

Guided observation sessions under professional supervision in various clinical settings. Group seminars are held to familiarize students as to the role of the rehabilitation team. *Prep.: HSL 3442 or permission of the instructor.*

HSL 3450 European Mountaineering

An intense six-day course that covers the basic skills of technical climbing. The course is conducted by the International School of Mountaineering. English-speaking guides extend all students to the utmost of their abilities in various climbing situations: free climbing; ice climbing near Chamonix, France; artificial climbing; or mountain rescue. Climbing is done in a voluntary, relaxed manner with the purpose of learning to enjoy the mountains creatively and safely.

HSL 3451 European Backpacking and Orienteering

A practical course in the basics of safe mountain living and travel on foot. Subjects covered include group leadership, fauna and flora of the Alpine environment, mountain geology, mountain first aid, and orienteering. Students have the opportunity to participate in several day hikes in the vicinity of Leysin, where scenic walking paths abound, and two extended back-packing trips in contrast-

ing areas of Switzerland. The European style of back-packing differs greatly from the traditional American practice of tenting, employing Alpine huts and refuges.

HSL 3452 Comparative European Recreation

A presentation of recreation, European-style. Guest lecturers, movies, group discussion, and field trips help to present the Western European approach to recreation and sport. The critical contemporary issues of facility construction, program structure and development, government support, and treatment of special populations are viewed through the European perspective and compared to the American scene. Among the topics included are recreation and tourism in a mountain society, the European club system, Swiss park construction, therapeutic recreation in Switzerland, mountain rescue, and tourism as a part of recreation. The outstanding recreation facilities of Geneva are visited during the course. A written test and paper are required.

HSL 3820 Practicum in Clinical Recreation

A minimum of seventy-five clock hours of supervised professional experience, required of those students who do not have a degree in Recreation and Leisure Studies or sufficient professional work experience. Students are assigned as interns to agencies or institutions that offer services in the area of therapeutic recreation and rehabilitation, community and municipal recreation, or commercial recreation. Credit not applicable toward degree.

Physical Therapy

PTH 3510 Cardiac Rehabilitation Programs Phases I and II (2 Q.H.)

Survey of various cardiac rehabilitation programs, their objectives, relevant medical considerations, indications, and contraindications. Topics for examination include referrals, organizational structure, proposal writing, liabilities, and insurance plans available for these two phases of rehabilitation. *Prep.: PTH 3560 or permission of instructor.*

PTH 3515 Pulmonary Rehabilitation Programs (2 Q.H.)

Theory and practice of pulmonary therapy. Analysis of treatment procedures utilized with medical and surgical respiratory patients. *Prep.: PTH 3560 or permission of instructor.*

PTH 3520 Surgical Conditions of Cardiac and Pulmonary Patients

Examination of current surgical treatment of cardiac and pulmonary anomalies in both the neonate and the adult. The techniques used in various surgical procedures are studied as well as preoperative, intraoperative, and postoperative patient

management. The role of the physical therapist is also investigated extensively. *Prep.: PTH 3560 Practicum in Physical Therapy I or permission of instructor.*

PTH 3500 Cardiopulmonary Pathophysiology

Lecture and laboratory study of anatomy, physiology, and pathophysiology for the cardiac and pulmonary systems as applied to the dysfunction and rehabilitation of the cardiopulmonary patient. *Prep.: HSL 3618.*

PTH 3505 Cardiopulmonary Diagnostic Techniques

An overview of the various noninvasive and invasive techniques for diagnostic purposes, including examination of these techniques as guidelines useful in determining the extent of cardiopulmonary damage, work capacity, and residual function. Techniques studied include electrocardiography, systolic time intervals, pulmonary function, laboratory test findings, and gas analysis. *Prep.: PTH 3560, HSL 3618, or permission of instructor.*

PTH 3525 Medical Conditions of Cardiac and Pulmonary Patients

Investigation of medical cardiac and pulmonary dysfunctions related to acute and chronic pathologic changes. The etiologies of cardiac and pulmonary anomalies are examined extensively. Medical management of the patient, the most recent research, and the interrelationship between physician and physical therapist are discussed. *Prep.: PTH 3560 Practicum in Physical Therapy I or consent of instructor.*

PTH 3530 Basic Applied Neuroanatomy

Study of the human nervous system from a functional perspective, including analysis of components of the nervous system as they relate to common clinical problems. Emphasis is placed upon the therapist's role in recognizing and treating these problems. *Prep.: Gross Human Anatomy or permission of instructor.*

PTH 3535 Advanced Functional Neuroanatomy

Anatomy of the nervous system is studied from a functional perspective. The course focuses on the role of the cortex, basal ganglia, thalamus, and cerebellum in regulation of tone control, sensation, and posture. Current and classic literature will be used. *Prep.: PTH 3530 Basic Applied Neuroanatomy.*

PTH 3540 Advanced Topics in Neurodevelopment

Examination and interpretation of both classic and current nonhuman and human research studies. Seminar format. *Prep.: One year of clinical experience in neurology or PTH 3560 Practicum in Physical Therapy I or permission of instructor.*

PTH 3545 Neuromuscular Physiology

Classic concepts of normal muscle and nerve structure and function. Clinical impacts of disease and injury on neuromuscular morphology and physiology are emphasized where appropriate. The course also gives the student the opportunity to become familiar with current theory that may be relevant to evaluation and management courses offered in the program.

PTH 3550 Evaluation of the Neurologically Impaired Adult

The course provides a framework for analyzing motor dysfunction, based on the fundamental properties underlying movement disorders. This framework is then used to critique current evaluations of neurologic disabilities and to develop a rationale for a logical and comprehensive evaluation of the neurologically impaired adult. *Prep.: PTH 3560 Practicum in Physical Therapy I or equivalent or permission of instructor.*

PTH 3555 Treatment of the Neurologically Impaired Adult

Treatment of the neurologically impaired adult is discussed from a historical perspective and from current neurological and neurophysiologic knowledge. Current techniques are critiqued from a clinical and theoretical point of view. Topics include specific treatment techniques as well as specific neurologic disabilities. *Prep.: One year clinical experience in physical therapy with background in treatment of neurologic patient and PTH 3550.*

PTH 3560 Practicum in Physical Therapy I

Practicum in supervised clinical practice within the specified specialty area. Students are expected to complete 240 hours of clinical experience in a health-care setting. *Required as a prerequisite in selected courses for those students who do not have a minimum of one year of clinical experience at the time of registration for these courses.*

PTH 3570 Evaluation of the Neurologically Impaired Infant and Child

Clinical test and measurement background information applied to advanced assessment and treatment approach for the pediatric neurological patient classically seen by the clinical specialist in neurological physical therapy. *Prep.: PTH 3540 Advanced Topics in Neurodevelopment.*

PTH 3575 Treatment of the Neurologically Impaired Infant and Child

Advanced treatments for the pediatric patient with neurological disorders are discussed and demonstrated. Experimental learning for clinical practice is included. *Prep.: PTH 3570 Evaluation of the Neurologically Impaired Infant and Child.*

Interdepartmental Courses

INT 3500 Research Design and Methodology

Research methods and designs used in health education, physical education, physical therapy, and recreation education. Emphasis is placed on the development of research techniques; including the ability to define research problems; write hypotheses; review and interpret literature; apply research designs; organize, analyze, and present

data; and draw relevant conclusions. *Prep.: Statistics or permission of instructor.*

INT 3540 Computer Applications for Nonprofit Organizations

An introductory course which presents ways in which generic software packages (database management, spreadsheets, business graphics, and

word processing) may be used to improve efficiency and effectiveness of individuals and organizations. Hardware and software configurations are discussed.

INT 3550 Instruction in LOGO

Philosophy and programming in the LOGO language form the primary emphases. Curriculum materials are demonstrated showing the use of the LOGO language in areas such as computer programming, mathematics, and language arts. Current research and applications of LOGO in the school curriculum are presented. Creation of individual LOGO projects in laboratory settings are required.

INT 3551 Instructional Programming in PASCAL

An introduction to computers and computer programming using the language PASCAL. Tools such as text editors are also discussed. Instructional applications are made where possible.

INT 3552 Computer Use for Educators (2 Q.H.)

Designed for educators with minimal computer experience, this course provides an introduction to word processing, data processing and file management. Functions of the operating system and the physical hardware are discussed. The BASIC programming language will be introduced. Students will have extensive hands-on experience in class and through accompanying supervised laboratories.

INT 3553 Word Processing for Educators

(2 Q.H.)

A variety of word processing software programs are taught. Applications of word processing ranging from simple one-page letters to documents and mail-merge are considered in this course. Students will have extensive hands-on experience with computers in class and through accompanying supervised laboratories.

INT 3554 Computers in Education

This course will focus on the use of computers both as a teaching methodology and as an administrative tool in education. The use of Computer Assisted Instruction (CAI) will be introduced through the BASIC programming language. A variety of microcomputer software packages suitable for classroom and administrative use will be tested in a laboratory setting. Extensive hands-on experience with a number of commercially available educational software packages is required. Strategies and methods for integrating computing within the elementary and secondary curriculum are highlighted.

INT 3555 Introduction to Computer Use for Professionals

Introduction to computer capabilities and limitations; selection of hardware/software; use of a line editor; introduction to system command

language; and introduction to data processing through a packaged library program such as SPSS, BDMP, MINITAB or IMSL.

INT 3556 Educational Applications of DBMS

Several general purpose software packages (database, spreadsheet, and data analysis) and simulations are used for working through such problems as scheduling/facilities usage, recordkeeping and general ledger/accounting, and survey/market research.

INT 3557 Instruction in LOGO II

This course represents a second course in the LOGO environment, emphasizing advanced concepts in LOGO, including the use of list-processing in language, music, physics, and mathematics. *Prep.: INT 3550.*

INT 3501 Thesis/Project I

Initiation of a scholarly investigation. Students are required to submit a written research proposal for approval by a thesis/project committee and to present an oral proposal at a college seminar. *Prep.: ED 3340, INT 3500, completion of two courses in area of concentration, and permission of program adviser.*

INT 3502 Thesis/Project II

The investigation proposed in Thesis/Project I implemented with, and culminating in, an approved written report in thesis form. *Prep.: INT 3501 Thesis/Project I.*

INT 3800 Independent Study

Under the guidance and direction of a program adviser, students have the opportunity to develop and conduct projects related to their professional interests. These projects are reported in thesis format when appropriate. (Credit arranged with program adviser.) *Prep.: Written proposal and permission of program adviser.*

INT 3503, 3504 Seminar/Workshop

Special seminars or workshops on interdepartmental topics of timely interest. Graduate credit may be granted for successful completion of a workshop, but credit may not be applied toward a degree program without the program adviser's approval. A maximum of eight quarter hours earned in seminars or workshops may be applied toward the degree.

Institutes

ED 3828, ED 3825, ED 3826, ED 3827, CRS 3803, SLA 3699, CRS 3805, CRS 3804, HSL 3898, HSL 3822, PTH 3801

A department may offer a special institute in a specific field of interest from time to time. The institute may be collaborative, offered by the several departments in the Boston-Bouvé College of Human Development Professions, and will usually include a special institute faculty drawn from resources outside the University, as well as from the Boston-Bouvé faculty. The institute focuses on a specific area of academic study and may be interdisciplinary in nature; it involves total time commitments on the part of participants in morning, afternoon, and evening sessions, five or six days per week, for one to eight weeks, depend-

ing upon the nature and scope of the institute. Institutes are customarily designed for participants who are currently employed in a common field of work and wish to receive additional preparation in new methods, new materials, and new content areas. Graduate credit may be granted for successful completion of an institute but may not be applied toward a degree program at the University without the approval of the departments in which students are doing their major field of specialization degree work. All institute participants must be degree candidates in the graduate school or must qualify, prior to registration, as special graduate students. *Prep.: Permission of institute instructor.*

Workshops

ED 3820, ED 3821, ED 3822, ED 3823, CRS 3806, SLA 3698, CRS 3808, CRS 3807, HSL 3899, HSL 3823, PTH 3802

A department may offer a special workshop in a specific field of interest from time to time. Emphasis in the workshop is focused on the development of instructional materials or the resolution of practical problems within a single school or institutional setting. Workshops may also be held for a group of potential participants who are currently em-

ployed in a common field of work. Graduate credit may be granted for successful completion of a workshop but may not be applied toward a degree program at the University without the approval of the departments in which students are doing their major field of specialization degree work. All workshop participants must be degree candidates in the graduate school or must qualify, prior to registration, as special graduate students. *Prep.: Permission of workshop instructor.*

Professional Accounting

Professional Accounting

ACC 3401 Accounting Problems I 5 Q.H.

An accelerated introduction to the basic accounting process and the preparation of general-purpose financial statements. Specific topics covered include cash, investment, receivables, inventories, current liabilities, and present value concepts. Completion of a self-instructed, programmed text on the basic accounting concepts. *Prep.: none.*

ACC 3402 Cost Accounting Theory and Problems 5 Q.H.

Specialized problems of cost accumulation and cost behavior are analyzed. Specific topics covered include: cost-volume-profit analysis, standard costs and budgeting, overhead analysis, and capital budgeting. Costs involved in managerial decision-making are given special attention. *Prep.: none.*

ACC 3404 Accounting Problems II 5 Q.H.

A continuation of ACC 3401 including coverage of the following topics: plant, property and equipment, depreciation, long-term liabilities, stockholders' equity, earnings per share, and accounting for income taxes. *Prep.: none.*

ACC 3405 Accounting Problems III 3 Q.H.

An examination of specialized accounting topics including pensions, leases, accounting changes, statement of changes in financial position, partnerships, and government accounting. *Prep.: none.*

ACC 3406 Advanced Accounting Problems 3 Q.H.

An examination of business combinations including the purchase and pooling methods. Specific topics covered include: intercompany profits, indirect and reciprocal holdings, and foreign currency translations. *Prep.: none.*

ACC 3407 Auditing Theory and Practice 5 Q.H.

An examination of auditing concepts, standards, and procedures. Topics covered include: the legal and ethical responsibilities of the auditor, statistical sampling, auditing and EDP, audit reports, and audit procedures. Emphasis is given to concepts and to understanding the nature and objectives of the audit process. *Prep.: none.*

ACC 3408 Federal Income Tax Accounting 6 Q.H.

A comprehensive study of the Internal Revenue Code, regulations, revenue rulings, and relevant cases. Emphasis is placed on taxation of individuals, corporations, partnerships, estates and trusts, tax-planning considerations, and tax research. *Prep.: none.*

ACC 3413 Contemporary Accounting Theory 5 Q.H.

An examination of current issues and trends in accounting that are of greatest concern to the accounting profession. The concepts and developments of the accounting profession. The concepts and developments of the theoretical aspects of accounting are explored. Authoritative pronouncements of various accounting organizations are examined. *Prep.: none.*

FIN 3414 Management of Financial Resources 5 Q.H.

The financial management of corporations and the principles governing the effective management of capital. The various sources of funds — short-, intermediate-, and long-term — are discussed in detail, using selected cases for illustrative purposes. Financial institutions such as the Securities and Exchange Commission (SEC), and the securities markets are also studied. *Prep.: none.*

HRM 3403 Organizational Behavior 5 Q.H.

An examination of behavior in business organizations. However, this knowledge is also applicable to nonprofit organizations such as schools, government agencies, and hospitals, including community groups, and social clubs. Students are given an opportunity to acquire knowledge of behavior and develop skill in dealing with it, and as they hope to affect and change it. *Prep.: none.*

MEC 3412 Managerial Economics (Quantitative Approach) 5 Q.H.

Decision-making under conditions of uncertainty: allocation of scarce resources, utilizing linear programming models, determination of the value of a marginal unit of a scarce resource (concept of shadow price), sensitivity analysis, examination of the most frequently encountered sampling distributions, determination of optimal decision rules, and economic models for estimating demand-and-cost relationship. *Prep.: none.*

MGT 3415 Business Law 5 Q.H.

Contracts, partnerships, corporations, agency, commercial paper, sales, and other topics essential for professional development in the business and legal environment. *Prep.: none.*

MGT 3416 Business Policy in a Societal Setting 5 Q.H.

Cases focus on business decisions confronting management. Examines policy decisions and their impact on various sectors of society, such as stockholders, customers, suppliers, the public and government. *Prep.: none.*

MKT 3410 Marketing**5 Q.H.**

Students have a chance to acquire a comprehensive understanding of basic marketing function, institutions, and concepts. They also have an opportunity to develop the ability to analyze and make recommendations of management problems involving the creation, distribution, and sale of goods and services. Topics include: consumer analysis, market research, and decisions as related to overall marketing strategy (product identification of target markets, specification of offerings, pricing, promotion, and distribution.) *Prep.: none.*

MSC 3409 Operations Management**4 Q.H.**

An introductory, graduate-level course emphasizing the organization and management of productive systems. The goal is to provide an introduction to the nature and types of organizations and management techniques used to control operations. The three major types of productive systems, which are flow, job, and project, are offered, focusing on standards, capacity, scheduling, inventory, and control. *Prep.: none.*

MSC 3411 Information Systems**4 Q.H.**

A nontechnical introduction to computers and information systems, focusing on issues relevant to audit and control. The first portion of the course delves into basic computer and information-systems concepts, including computer hardware, software, and systems development. Following this aspect, emphasis is placed on managing, planning, and controlling the computer resource, security and privacy issues, and computer auditing. Students will be expected to have become familiar with elementary computer programming and the use of Northeastern's time-sharing terminals. *Prep.: none.*

MSC 3420 Computer Programming: An Introduction**0 Q.H.**

The information systems course (MSC 3411), scheduled for the spring quarter, presumes that students will have acquired an understanding of the art of computer programming, which uses the language referred to as BASIC. This noncredit course is designed to provide the necessary background for students having inadequate preparation. Offered on a pass-fail basis, the course may be waived by permission of the instructor. *Prep.: none.*

Computer Science

Computer Science

COM 3200 Computer Architecture 4 Q.H.
Organization of machines and computations. Computer System capacity. Processors. Control units. Memories and memory hierarchies. Inter-connection networks. Different computer architectures are studied by examining the corresponding languages and assemblers.

COM 3205 Software Design and Development 4 Q.H.
Students work in groups to organize, manage and implement a large scale programming project. Topics considered are: software planning; software methodologies, e.g., functional decomposition, data flow design, data structure design, programming calculus; several large examples of program design; software testing and reliability. *Prereq.: COM 1201 or equivalent.*

COM 3315 Database Management Systems I 4 Q.H.
Concepts and structures necessary to design and implement a DBMS application. Introduction to database concepts. Database modeling. Hierarchical, network and relational models. Data definition and manipulation languages. Design theory for relational models. Query optimization. Integrity, security, recovery and concurrency in database systems. *Prereq.: COM 1310, COM 1315 or equivalent.*

COM 3316 Database Management Systems II 4 Q.H.
Specification, design and implementation of a simple DMBS. Practical database design issues and methodology. Discussion of conceptual implementation and physical design. Techniques to evaluate design alternatives and tradeoffs. Analysis of primary and secondary access methods for performance of database operations and for storage space. *Prereq.: COM 3315.*

COM 3336 Operating Systems 4 Q.H.
Design and implementation of an operating system. Algorithms for concurrent processes, deadlock resolution, process management, performance evaluation and monitoring. Students work on a project implementing a small operating system or extending an existing one. *Prereq.: An undergraduate operating systems or systems programming course.*

COM 3350 Theory of Computation 4 Q.H.
Formal models of computation including Turing machines and partial recursive functions; Turing-decidability and unsolvable problems. Computational complexity, the class P and NP, some NP-complete problems. *Prereq.: COM 1350 or equivalent.*

COM 3355 Compiler Construction I 4 Q.H.
Advanced concepts and principles of compiler design including an overview of compiler structures.

Topics also cover: syntax-directed compilation, translation and interpretation, the relation between syntax and semantics, the relation between high level programming languages and compilers, between finite state machines and lexical analysis, between context-free languages, parsing trees and the syntactic specification of programming languages and some parsing techniques such as shift-reduce parsing, operator-precedence parsing, top-down parsing and predictive parsers. Selected current research papers and articles are used as references.

COM 3356 Compiler Construction II 4 Q.H.
Further investigations of compiler construction including principles of syntax-directed translation, simple SDTS and top-down transducers, simple post-fix SDTS and bottom-up transducers. Topics like bottom-up parsing, LR(k), LALR parsing, code generation, symbol table structures, error detection and recovery and code optimization are also discussed. Selected current papers and articles are used for discussion.

COM 3370 Advanced Computer Graphics 4 Q.H.
Selected advanced topics in computer graphics chosen from the following list: area fill algorithms, the aliasing problem in line drawing, 3 dimensional graphics, geometric transforms, hidden surface algorithms, curve and surface approximation techniques, solid primitives, color and shading, approaches to obtaining realistic images. *Prereq.: An introductory course in computer graphics.*

COM 3390 Analysis of Algorithms 4 Q.H.
Design and analysis of fast algorithms. Topics are chosen from: 1) Advanced data structures: representing partitions, union-find algorithms, priority queues; 2) Graph algorithms: biconnectivity, maximum flow, shortest path, matching, minimum spanning tree; 3) Algebraic problems: Matrix multiplication, polynomial multiplication, string matching, linear programming; 4) Probabilistic algorithms: tests for primality, factoring polynomials and integers. *Prereq.: COM 1201, COM 1390, MTH 1409 or MTH 1410, MTH 1301 or MTH 3102 or equivalent.*

COM 3420 Knowledge Representation and Inferencing 4 Q.H.
Knowledge representation, acquisition and utilization. Frames, scripts, conceptual dependency. Forward and backward chaining, unification and resolution, non-monotonic reasoning. Rote learning, learning by analogy, consistency checking. *Prereq.: COM 1410 or equivalent.*

COM 3430 Expert Systems 4 Q.H.
Architectures used in the design of expert systems. Survey of current systems. Use of system building tools such as ROSIE. Natures of expertise

in a domain. Symbols, search, reasoning. Production systems. *Prereq.: COM 1410 or equivalent.*

COM 3440 Natural Language Processing

4 Q.H.

Essentials of natural language understanding and production. Focus is on semantic and pragmatic issues rather than syntactic or phonological. Elements in the design of NL human-computer interfaces. Dialog control. Lexical-semantic relations, semantic primitives, and the structure of text. *Prereq.: COM 3420*

COM 3450 Syntactic Pattern Recognition

4 Q.H.

Introduction to syntactic pattern recognition and comparison with the classical discriminant approach. A survey of various syntactic pattern recognition techniques, such as picture descriptive languages (PDL), formal grammars, array grammars, tessellation structures, sequential/parallel matrix grammars, and histogram approaches. Syntax analysis as a recognition procedure. Grammatical inference for syntactic pattern recognition. Applications of syntactic pattern recognition to selected problems in industry, the military, and business, including robotics. *Prereq.: COM 1350 or equivalent.*

COM 3460 Intelligent Computer-Assisted Instruction

4 Q.H.

The notion of course material independent of teaching procedures. Problems and comments individualized for each student. System tutor with reactive learning environments. Examples for SCHOLAR and GUIDON. Group development of intelligent instructional systems. *Prereq.: COM 3420.*

COM 3510 Computer Communication Networks: Design & Performance

4 Q.H.

A study of interacting computers. Topics include: elementary queueing theory, connectivity theory, data link and transport protocols, slot rings, token rings and CSMA, routing algorithms, performance analysis of networks. Additional topics may be chosen from models of networks or of network protocols, error detection and correction, applications protocols such as virtual terminal or file transfer protocols. *Prereq.: COM 1201, MTH 1387, MTH 1409 or MTH 1410*

COM 3520 Cryptography and Computer Security

4 Q.H.

Design and use of cryptographic systems and cryptanalytic attacks; a history of cryptographic systems and the mathematics behind them; shift register sequences; random number generators; DES; public key systems and their applications. *Prereq.: COM 1350, MTH 1387, MTH 1409 or MTH 1410, MTH 1390 or equivalent.*

COM 3560 Distributed Database Systems

4 Q.H.

A consideration of the problems and opportunities inherent in distributed data bases on a network of

computer systems. Includes file allocation, directory systems, deadlock detection and prevention synchronization, query optimization, and fault tolerance. *Prereq.: COM 3316, COM 3510*

COM 3570 Office Automation

4 Q.H.

The structure and impact of telecommunications and distributed processing on management information systems and decision support systems. Electronic mail systems, teleconferencing, and videotex. Microcomputer networks network software, and operating systems. *Prereq.: COM 3510.*

COM 3580 Principles of Interactive Systems Design

4 Q.H.

Principles for optimal design of interactive systems such as text editors, programming environments, automated banking systems and commercial products for nontechnical users such as decision support systems, word processors, personal computers, etc. User characteristics which impact systems design. Impact of current technologies such as touch screens, mice and other pointing devices, sophisticated graphics, data integration, etc., on interaction style. Survey of styles of interaction including menus, command languages, forms fill-in. Object-oriented vs. application-oriented interfaces. Optimizing design tradeoffs.

COM 3585 Methods in Interactive Systems Design

4 Q.H.

Survey of the research and methodology in the design of interactive systems. Introduction to experimental methodologies applied in the study of styles of interaction: field studies, controlled laboratory experiments, protocol analysis. Survey and critique of research on various aspects of interaction such as dialogue style, filing and retrieval mechanisms, command languages, menu design, input devices, message and error handling and screen layout. *Prereq.: COM 3580.*

COM 3630 Concurrent Programming

4 Q.H.

The logical problems that arise in concurrency and their machine implementations. Mutual exclusion, message passing, deadlock, monitors, kernels, and applications to operating systems. *Prereq.: COM 3336.*

COM 3640 Parallel Computation

4 Q.H.

Algorithms and theories for parallel computation on fixed-connection networks and on concurrent systems having a fixed number of processors. Included are algorithms for sorting, priority queues, graph algorithms, matrix multiplication, and FFT. Students use a network of micros to implement some of these algorithms. Applications to VSI design may be included. *Prereq.: COM 3336, COM 3390.*

COM 3800 Readings in Computer Science

4 Q.H.

Selected readings under the supervision of a faculty member. *Prereq.: Core courses and permission of instructor.*

COM 3810 Special Topics in Computer Science

Faculty will lecture on current topics in computer science. Topics will vary from quarter to quarter. May be taken up to three times for credit, with changes in topics. *Prereq.: Core courses or permission of instructor.*

COM 3820 Computer Science Master's Thesis

May be repeated for credit. *Prereq.: Agreement of a thesis advisor.*

COM 3830 Computer Science Master's Project

May be repeated for credit. *Prereq.: Agreement of a project supervisor.*

COM 3840 Seminar in Computer Science

Students will read and present various survey and research papers in Computer Science. Faculty supervisor and topics will vary from quarter to quarter. May be repeated for credit. *Prereq.: Core courses or permission of instructor.*

Criminal Justice

Criminal Justice

The following course descriptions, listed numerically by area of concentration, are representative of the courses offered in the graduate Criminal Justice program. As it is not possible to offer all courses each year, students are urged to consult the most current announcement of course offerings for specific information regarding available courses in any given quarter. All courses described here carry three quarter-hours of credit.

CJ 3201 The Criminal Justice Process

An analysis of the criminal justice process from prevention and arrest to release after incarceration, emphasizing a legal, sociological, and policy approach to criminal justice. The philosophies, practices, procedures, and issues of agencies involved in criminal justice are reviewed. Critical attention is also given to different approaches to crime control.

CJ 3202 Theories of Criminology

Focuses on the use of scientific methods in the study and analysis of regularities, uniformities, patterns, and causal factors related to crime, the criminal, and social reactions to both. Critical contributions to the study of crime, criminals, and the treatment of offenders are analyzed as they emerge from writings in such disciplines as biology, psychology, psychiatry, endocrinology, law, sociology and anthropology.

CJ 3203 Criminal Law

The fundamental principles and concepts of criminal law in the United States. This course focuses on the relationship of the individual to the state and includes an examination of the general framework of criminal law.

CJ 3204 Statistical Analysis I

Introduction to probability and statistics. Topics to be covered include measures of central tendency and dispersion; probability and the binomial, Poisson, exponential, and normal distributions; sampling distributions and hypothesis testing; and correlation and regression.

CJ 3251 Criminal Justice Planning and Development

An examination of planning techniques and their impact on criminal justice program development, currently and for the future. An analysis of policy and decision making pertaining to criminal justice organizations and agencies is developed as is the extent of planning for crime control at local, state, regional, and national levels. The peculiar nature of urban problems in relation to planning is also reviewed, involving identifying problem areas in the field of criminal justice, diagnosing their causes, and formulating solutions. In addition, the course examines alternative strategies and mobilization of resources necessary to effect change in the system.

CJ 3252 Criminal Justice Management

The fundamentals of management as applied to the field of criminal justice, with a specific focus on the need for criminal justice improvement

through the management of change. Special attention is given to planning, organizing, staffing, directing, coordinating, keeping records, and budgeting (POSDCORB) within the various functional agencies of criminal justice. The latest developments in administration and management are discussed as they apply to criminal justice operations, both at the administrative and supervisory levels. Management tools such as Program Evaluation Review Techniques (PERT); Gantt Charts; Operations Research; Planning, Programming, Budgeting, Systems (PPBS); and the use of sophisticated computer software to facilitate both routine operations and management decision making are explored. Understanding and using the computer and systems technology for problem solving, evaluation, personnel assignments, perpetual inventories, and management research constitute a major emphasis of the course.

CJ 3253 Personnel and Labor Relations in Criminal Justice

— This course helps to provide the student with basic skills in personnel management, selection, and placement. It is also intended to help students develop an understanding of the social psychology of organizations concerned with law enforcement, the courts, or corrections, and to help them develop familiarity with critical issues in labor relations and collective bargaining.

CJ 3254 Budget and Financing in Criminal Justice

The principles and practices of budgeting in the various functional areas of criminal justice. Financial operations are dealt with in depth, including such matters as obtaining resources through budget development and presentation. Distinctions between capital budgets and expense budgets and among zero budgeting, line-item budgeting, and program budgeting are drawn. Important financial concerns such as cost effectiveness, management by objectives, and critical path method (CPM) are discussed. Special attention is given to budget projections as planning tools for obtaining grants, as well as a means of facilitating needed change within the present structures of criminal justice agencies. The utility of budgets as evaluative mechanisms is stressed; and the role of budgeting in the financial control of organizations is discussed.

CJ 3301 Administration of Private Security

A comprehensive overview of private security theories, operations, and practices, with special

emphasis on the administration and management of security. The philosophical background, history, and current role of private security are explored, as well as the role and status of the security manager in threat assessment, risk prevention, and the protection of assets. Functional-area security systems, law, science and technology for security, and issues, standards, goals, and challenges for the future are dealt with in the course. Security systems are considered, particularly as these "open" systems relate to criminal justice and the environment. The security manager is conceived of as the prime mover toward professionalization and improved management and administration of security operations, and as the advocate of contemporary organizational theories embracing research and the systems approach.

CJ 3302 Legal Issues in Private Security

The legal factors that affect security operations and administration and the value of legal counsel on such factors. These factors include the pertinent aspects of torts, agency, civil rights, contracts, trade secrets, patents and copyrights, insurance, and regulatory issues.

CJ 3303 Science and Technology in Private Security

Considers security applications of the latest scientific and technological advances and the impact of new product developments on prevention and protection, detection, and prosecution. Students will examine the state of the art of security products and are invited to plan, implement, maintain, and evaluate highly sophisticated security systems.

CJ 3304 Human Factors in Security

An analysis of topics and strategies for security administration. Executive development, ethical issues, stress management, conflict management, crisis management, intra-organizational relations, community agency relations, promoting security awareness, staff development, and effective security personnel and product interface.

CJ 3351 Theories of Law and Society

An introduction to theories, issues, and research related to law and legal institutions, placing law in the context of social control systems, raising basic issues about the nature of law, and focusing on the relationship between law and social values. The course also considers the nature of law, law and social change, the sociology of the legal profession, and criminal law in action. Attention is given to the formulation of criminal law and discrimination in the formulation and practice of criminal law.

CJ 3352 Statistical Analysis II

A continuation of Statistical Analysis I. Multiple regression and its extensions, discriminant analysis, factor analysis, analysis of variance, and the analysis of contingency tables are discussed. *Prep.: HCJ 3204.*

CJ 3353 Research Methods in Criminal Justice

A survey of methodological approaches to criminal justice research. Various research strategies, including sample surveys, observation, historical research, experiments, and evaluation, are discussed and highlighted with examples from the literature. Also reviewed are various sources of criminal justice data, and their reliability and validity are assessed. Various data analytic strategies, including tabular analysis and nonparametric methods, are emphasized within the context of computer assignments.

CJ 3354 Criminal Behavior Systems

This course examines offender and offense patterns within nine general crime categories: (1) violent personal, (2) conventional property, (3) public order, (4) political, against the government, (5) political, by the government, (6) occupational, (7) "organized," (8) professional, and (9) sexual. The course is intended to serve as a detailed introductory survey to help familiarize graduate students with a broad range of crime types and criminal behavior systems as well as some of their classic and contemporary analyses.

CJ 3410 Forensic Serology I

Intended as a complete academic treatment of the subjects included and a useful and practical basis from which a forensic scientist may make a reasonable start. Methods of collecting samples and the evaluation and distribution of blood, either at the scene of the crime or on items submitted for laboratory examination, are included as well as the scientific techniques used in the laboratory. The most common and widely accepted of the serological techniques as well as the nomenclature associated with the field will be discussed. The laboratory portion of the course will allow the student to perform these tests.

CJ 3411 Forensic Serology II

Specializes in the identification of stains of blood and other body fluids and the typing of genetic markers present in these stains using, for the most part, electrophoresis.

CJ 3412 Forensic Toxicology

Forensic Toxicology is concerned with the medico-legal aspects of the harmful effects of chemicals upon humans and animals. The course will deal with techniques for the isolation, detection, and estimation of toxic substances in biologic materials in order to aid in establishing the cause or the circumstances of death in a post-mortem investigation. It also offers a basic understanding of the fundamentals of drug actions and reactions.

CJ 3413 Crime Scene Investigation

Procedures for sketching, searching, and photographing various crime scenes. Recognition, collection, marking, and handling of physical evidence with emphasis upon maintaining the chemical integrity of each sample. Examples of the types of analyses one should expect from a foren-

CJ 3511 Theories of Delinquency

Examines critically the major theoretical explanations of juvenile delinquency. Theoretical approaches include social disorganization, sub-cultural theory, strain, control theory, labeling and conflict theory. In addition, current data on the nature and distribution of delinquency are discussed, and findings from empirical research are highlighted.

CJ 3512 Penology and Corrections

The meaning and efficacy of punishment, the history of imprisonment, the structure of prisons, the effectiveness of treatment, the rights of prisoners, and sentencing policy.

CJ 3513 Crime Victims

Critically examines theories and research regarding victims of crime. Special attention is devoted to an analysis of National Crime Survey victimization data. Also concepts such as fear of crime, victim vulnerability, and victim culpability are discussed. In addition, implications of victim-oriented research for the administration of justice are assessed, as are current programs offering victim services such as restitution and compensation. Future trends in theory, research, and public policy are analyzed.

CJ 3514 Police Functions in Democratic Society

An examination of the sociopolitical context within which American police departments developed in the nineteenth century as well as the changing forces that shape modern departments. Considers the implications of democratic institutions and traditions for policing in America. The organization of several different kinds of departments are contrasted, and the implications of these different types of departments for police performance are examined. The rigors of police work, together with the social-psychological adjustments that officers at different ranks make, is also considered.

CJ 3515 Women and the Criminal Justice System

An examination of the roles of women in the criminal justice system. The course focuses on women as offenders, as victims, and as agents of social control; on both theory and practice, and on both historical and contemporary issues.

CJ 3516 Court Management and Administration

The organization and structure of the courts, including the problems, policies, and practices of the criminal court system. Particular emphasis is placed on the lower criminal court. Issues in court management, including personnel problems, scheduling, role of juries and witnesses, use of planning and management techniques, and court reform, are reviewed.

CJ 3517 Terrorism

Divided into two sections, the first part of which examines the sociology of terrorism, including

funding, intelligence gathering, weapons and tactics, informers, and countermeasures. Special attention is also given to the media which report the news, yet seem often perilously close to inciting further terror. The "terrorist personality," the literary depiction of terrorism, and the doctrine of systematic terrorism, as well as its current interpretations and common patterns, motives, and aims, are also examined.

The second part concentrates on identifying technologies of counterterrorism, discussing incident management needs, and recommending ways to lessen the risk of nationally disruptive acts. The course attempts to challenge accepted assumptions and to forecast changes in terrorist activities that may affect tomorrow's headlines.

CJ 3518 Juvenile Justice

A critical analysis of the policies and practices of agencies involved in processing young people through the juvenile justice system. Specific attention is devoted to police practices, detention, intake, diversion, adjudication, and disposition of juveniles within the justice system. In addition, the course focuses on the historical development of the juvenile justice system and assesses current trends and proposals for reform.

CJ 3520 Conflict Management

An examination of problems in conflict management, including concepts and definitions of social conflict and comparisons between functional and dysfunctional conflict. Inquiries into representative conflict management strategies and techniques are made, affording the opportunity to relate general theory and research results to practical situations of criminal conflict management. The course generally relies on a variety of heuristic techniques, including scenarios, role playing, and the use of audiovisual media.

CJ 3521 Probation and Parole

An examination of the nature, objectives, means, and problems of probation and parole administration and management.

CJ 3523 Law Enforcement and the Community

This course examines the nature, problems, and present procedures associated with police-community relations in order to develop more efficient and effective policing. The course utilizes the lecture-forum technique with assigned readings, group discussions, and project development and critiquing.

CJ 3524 Theories of Punishment

An overview of theories and issues in punishment with a focus on topics of contemporary interest as well as the historical roots of current approaches. Trends and fashions in both the theory and the form of punishment are considered. Reading materials are drawn from a variety of fields, including philosophy, politics, literature, law, and empirical criminal justice.

sic laboratory, their value and limitations. No knowledge of chemistry is required.

CJ 3414 Arson and Explosives

Emphasis is on the chemistry of explosives, propellants, accelerants, and other combustible materials. Sessions include the recovery, analysis, and evaluation of physical evidence from fires and explosions. *Prep.: C CHM 3430 and H CJ 3415 or consent of instructor.*

CJ 3415 Forensic Materials

Fundamental types of solids, such as metals, ceramics, minerals, and organic solids, including polymers, plastics, and fibers; their properties and analyses, using modern techniques. Methods of bulk and particle analysis. Elements of forensic geology. Determining the chemical and physical properties of forensically important materials, such as alloys, glass, soils, fibers, wood, paper and rubber.

CJ 3416 Forensic Chemistry Techniques I

Identification and characterization of micro- and macroscopic items of physical evidence, based upon their measurable properties; optical, comparison, polarizing, and scanning electron microscopy of glass, soil, hairs, and fibers; analyzing paints, plastics, and varnishes. Introduction to chemical methods used in firearm and toolmark examinations and the evaluation of residues remaining on hands or clothing after a firearm has been fired.

CJ 3417 Forensic Chemistry Techniques II

Introduction to the analysis of biological items of physical evidence. Pharmacology and toxicology of medicinal and chemical substances having potential for misuse or abuse. Further identification and characterization of potential forms of physical evidence, including glass, soil, toolmarks, and questioned documents. Brief look at how to present expert testimony in court.

CJ 3418 Seminar

Oral reports by participants on current concepts in forensic chemistry and criminalistics.

CJ 3501 Security Operations and Methods

A conceptual approach examining selected theories and methodologies used in the operations of private and public security programs. It addresses those aspects of loss prevention and protection directly related to security operations as well as those upon which security operations have an indirect, but no less important, impact. The differences between private security and public law enforcement are examined in terms of their perspectives and operations. It considers not only the primary objectives of security programs, but also the different business and institutional aspects involved and the methods best designed to achieve program objectives.

CJ 3503 Criminal Evidence

An introduction to the field of criminal evidence. Students are expected to read and brief cases and must be prepared to discuss them in class. The readings, class lectures, and discussions help familiarize students with the various procedures and rules related to the trial of a criminal case.

CJ 3505 Juvenile Law and Children's Rights

An examination of the legal relationship between the juvenile offender and the state. The course covers case and statutory law, as well as constitutional due-process standards in juvenile proceedings. Areas covered include jurisdiction, prejudicial process, waiver of jurisdiction adjudication, disposition, and postdispositional issues, including right to treatment.

CJ 3506 Criminal Procedures

Constitutional issues of the administration of criminal justice. Topics to be considered include selected provisions of the United States Constitution, with particular emphasis on Amendments 4, 5, 6, and 14, and on questions of electronic surveillance, right to counsel, line-up, bails, and right to speedy trial.

CJ 3508 Quantitative Models in Criminal Justice

Quantitative frontiers in the field of criminal justice as well as the methodological contributions of allied fields are examined: in particular, such approaches as reliability models of recidivism, stochastic models of criminal careers, economic models of criminal behavior, econometric models of the criminal justice system, and deterrence models are addressed. An extensive coverage of published and unpublished literature is central to the course.

CJ 3509 Crime Measurement

The amount, distribution, and pattern of criminal behavior in the United States are examined via official crime statistics including the Uniform Crime Reports, victimization surveys, and self-report studies. Alternative measures including indices of seriousness of various offenses are reviewed. Attention is also devoted to historical studies of the nature and extent of criminal behavior. Finally, problems and prospects regarding accurate measures of crime and crime correlates are discussed.

CJ 3510 Computer Applications in Criminal Justice

An introduction to the computer and its applicability to criminal justice, research, and operations. Topics covered include command language, file creation and editing, data storage modes, introductory FORTRAN, simulation, graphics, and word processing. Course requirements include a series of computer assignments concerning criminal data and problems.

CJ 3525 Correctional Administration

An intensive coverage of the many problems and dilemmas which confront the correctional organization. Topics for discussion include such issues as basic problems of correctional organization, organizational development and analysis, management by objectives, planning and budgeting systems, management style and personnel development, special problems of jails and houses of corrections, institutional programs, classifications, correctional policy, and the future of imprisonment.

CJ 3527 Community Corrections

This course examines the concepts of community corrections, utilizing historical, philosophical, and pragmatic perspectives and including an analysis of the alternatives to imprisonment or institutionalization. For course purposes, community-based programs are defined as programs aimed at reducing the occurrence of criminal and delinquent behavior through prevention, rehabilitation, reintegration, and/or diversionary services in noninstitutional settings which make maximum use of existing and potential community resources.

CJ 3529 Comparative Criminology

Crime and its control from the comparative perspective, viewed both historically and contemporaneously. The development of Roman legal institutions, the emergence of common law and other legal systems (the civil law and the socialist legal system), and the emergence of American legal institutions in the nineteenth century are all examined. The crime problems in developing societies (India, nineteenth-century Europe and America) are contrasted with those in developed societies (modern Europe and America), and the impact of a world economic system on the two is explored. The advantages of comparative analysis are developed.

CJ 3531 White Collar Crime

This course is designed to examine critically the current theoretical, research, and public policy issues regarding white collar crime. The first part examines definitions of white collar crime as well as various typologies of white collar crime activity. The nature, extent, and consequences of white collar crime in the United States will also be assessed. Finally, explanations for the commission of these offenses will be discussed. The second part uses case studies to explore in more detail white collar crime. For example, cases of employee theft, corporate crime, governmental deviance, industrial espionage, and computer crime

will be presented and discussed. The third part focuses on controlling white collar crime. The problems of traditional criminal justice systems in controlling white collar crime will be examined and the prospects of alternative systems of control—civil law, private security, public opinion—will be assessed.

CJ 3801, CJ 3802 Directed Study I and II

An independent study offers the student the opportunity to bring individual, concentrated attention to a particular topic as arranged and agreed upon in advance by a faculty member and the student. This option is generally recommended when the student desires a more intensive analysis of a particular subject. The independent study has the advantage of allowing students flexibility in learning and developing their own academic programs.

CJ 3803, CJ 3804 Internship I and II

Field instruction in a criminal justice agency where instruction may be offered through administrative, research, teaching and/or related activities. Students have the opportunity to apply theoretical concepts in a practical, applied fashion by observing and contributing to the daily activities of operating agencies and organizations.

CJ 3805 Masters Thesis

Students electing to write a Master's thesis must select a thesis topic with the advice of a faculty member and receive approval of the thesis topic from the graduate director.

CJ 3810 Forensic Science Master's Paper

An original work based upon library and/or laboratory research. Particular emphasis is placed on originality, clarity of thought, and simplicity of presentation, which is essential in presenting expert testimony in court.

CJ 3820 Forensic Directed Study I

A directed study in an area of forensic chemistry involving laboratory and/or literature research. Work is supervised by a qualified person and the director of the graduate programs. Specific projects will be decided at the time of application.

CJ 3821 Forensic Directed Study II

A directed study in some area of forensic chemistry involving either laboratory or library research under the direction of a qualified person and the director of graduate programs. The goal of this directed study is to provide the student with more intensive instruction in a particular area than is available in the forensic courses.

Engineering

Engineering

Chemical Engineering

Each course description includes information on the expected quarter in which classes are usually offered. The quarters listed are presented here for planning purposes; however, the Graduate School of Engineering cannot guarantee that all courses will be offered. Students must refer to the Graduate School of Engineering Quarterly Course Offering sheets to determine what courses are actually offered in any given quarter and at what day and time.

CHE 3300 Chemical Engineering Mathematics 4QH

(formerly 04.802) Fall Quarter, Alternating Years

Formulation and solution of problems involving advanced calculus as they arise in chemical engineering situations. Methods covered will include ordinary differential equations, series solutions, complex variables. Laplace transforms, partial differential equations, and matrix operations. Emphasis will be placed on methods for formulating the problems. It will be assumed that the student has been exposed to some of these topics in appropriate mathematics courses. *Prep. BS degree in Chemical Engineering including mathematical analysis.*

CHE 3301 Chemical Engineering Mathematics 2QH

Fall Quarter, As Announced

CHE 3301 and CHE 3302 cover the same material with the same prerequisites as CHE 3300, but in two 2QH courses.

CHE 3302 Chemical Engineering Mathematics II 2QH

Winter Quarter, As Announced

Continuation of CHE 3301. *Prep. CHE 3301.*

CHE 3310 Chemical Engineering Thermodynamics I 4QH

(formerly 04.811) Winter Quarter, Alternating Years

Classical thermodynamics as a method of approach to the analysis of processes of interest to chemical engineers. A study of phase equilibria involving the various states of matter; prediction and correlation of physical, chemical, and transport properties of gases and liquids; elementary concepts of quantum and statistical mechanics to interpret the empirical properties of classical thermodynamics. Fundamental principles are reviewed to the extent needed. *Prep. BS degree in Chemical Engineering.*

CHE 3311 Chemical Engineering Thermodynamics I 2QH

Winter Quarter, As Announced

CHE 3311 and CHE 3312 cover the same material with the same prerequisites as CHE 3310, but in two 2QH courses.

CHE 3312 Chemical Engineering Thermodynamics II 2QH

Spring Quarter, As Announced

Continuation of CHE 3311. *Prep. CHE 3311.*

CHE 3320 Separation Process 4QH

(formerly 04.978) Spring Quarter, Alternating Years

Calculation and design methods used in processes involving mass transfer. Topics covered include vapor liquid equilibria for binary and multicomponent systems, multicomponent distillation, absorption and extraction. Emphasis is placed on methods and techniques which are common to many separation processes. *Prep. BS degree in Chemical Engineering.*

CHE 3321 Separation Processes I 2QH

Winter Quarter, As Announced

CHE 3321 and CHE 3322 cover the same material with the same prerequisites as CHE 3320, but in two 2QH courses.

CHE 3322 Separation Processes 2QH

Spring Quarter, As Announced

Continuation of CHE 3321. *Prep. CHE 3321.*

CHE 3330 Chemical Process Control 4QH

(formerly 04.829) Fall Quarter, Alternating Years

Review of classical control techniques; state variable representation and analysis of continuous control systems in chemical engineering, including controllability, observability, and stability. Multivariable control problems in chemical engineering; introduction to optimal control. Digital simulation included where appropriate. *Prep. Graduate standing in Chemical Engineering or permission.*

CHE 3331 Chemical Process Control I 2QH

Fall Quarter, As Announced

CHE 3331 and CHE 3332 cover the same material with the same prerequisites as CHE 3330, but in two 2QH courses.

CHE 3332 Chemical Process Control II 2QH

Winter Quarter, As Announced

Continuation of CHE 3331. *Prep. CHE 3331.*

CHE 3340 Heterogeneous Catalysis 4QH

(formerly 04.890) Winter Quarter, Alternating Years

Experimental methods required for determining the surface area and pore structure of catalyst carriers are discussed. These structural characteristics are utilized to estimate mass and heat transport rates within porous catalysts in order to determine their effectiveness with respect to chemical reaction. Mechanisms for chemical poisoning of catalysts are also analyzed. Reactions of practical interest are used to illustrate the applications of

heterogeneous catalysis to modern chemical processing problems. *Prep. BS degree in Chemical Engineering.*

CHE 3341 Heterogeneous Catalysis I 2QH
Winter Quarter, As Announced

CHE 3341 and CHE 3342 cover the same material with the same prerequisites as CHE 3340, but in two 2QH courses.

CHE 3342 Heterogeneous Catalysis II 2QH
Spring Quarter, As Announced

Continuation of CHE 3341. *Prep. CHE 3341.*

CHE 3350 Chemical Process Heat Transfer 4QH
(formerly 04.973) Spring Quarter, Alternating Years

Empirical methods and calculations used to design heat transfer equipment for the chemical process industries. Review of basic heat transfer principles. Shell-and-tube calculations for liquid and/or vapor phase heat transfer. Direct contact and other special heat exchanger applications. *Prep. BS degree in Chemical Engineering.*

CHE 3351 Chemical Process Heat Transfer I 2QH
Winter Quarter, As Announced

CHE 3351 and CHE 3352 cover the same material with the same prerequisites as CHE 3350, but in two 2QH courses.

CHE 3352 Chemical Process Heat Transfer II 2QH
Spring Quarter, As Announced

Continuation of CHE 3351. *Prep. CHE 3351.*

CHE 3400 Advance Chemical Engineering Calculations 4QH
(formerly 04.801) As Announced

Fundamental process principles leading to an understanding of the stoichiometric principles of chemical process plants. The study of complex material and energy balances is undertaken with the view to apply these principles to actual large chemical plant conditions. *Prep. BS degree in Chemical Engineering including differential equations.*

CHE 3401 Advanced Chemical Engineering Calculations I 2QH
As Announced

CHE 3401 and CHE 3402 cover the same material with the same prerequisites as CHE 3400, but in two 2QH courses.

CHE 3402 Advanced Chemical Engineering Calculations II 2QH
As Announced

Continuation of CHE 3401. *Prep. CHE 3401.*

CHE 3410 Numerical Techniques in Chemical Engineering 4QH
(formerly 04.803) Fall Quarter, As Announced

Digital computer applications to chemical engineering problems. Topics covered include loca-

tion of roots of linear and nonlinear equations, numerical integration, and curve-fitting techniques with emphasis on the numerical solution of ordinary and partial differential equations and to the subject of linear algebra. *Prep. BS degree in Chemical Engineering.*

CHE 3411 Numerical Techniques in Chemical Engineering I 2QH

Fall Quarter, As Announced

CHE 3411 and CHE 3412 cover the same material with the same prerequisites as CHE 3410, but in two 2QH courses.

CHE 3412 Numerical Techniques in Chemical Engineering 2QH

Winter Quarter, As Announced

Continuation of CHE 3411. *Prep. CHE 3411.*

CHE 3430 Chemical Data Estimation 2QH
(formerly 04.832) As Announced

Methods of obtaining physical and thermodynamic properties of chemical compounds and systems without resorting to laboratory investigation. Latest empirical relationships and physical and thermodynamics laws are introduced to obtain data for plant design and other chemical and engineering uses. *Prep. BS degree.*

CHE 3450 Analytical and Numerical Techniques 4QH
(formerly 04.835) As Announced

For students interested in solving comprehensive problems using computer methods. Problems solved in the course will be based on the interest of the students and staff and will be individual. *Prep. BS degree and knowledge of digital computer programming.*

CHE 3500 Transport Phenomena 4QH
(formerly 04.823) Winter Quarter, As Announced

Momentum rate conservation equations for steady-state fluid flow in two-dimensional boundary layers are presented and solved to obtain the fluid velocity profiles. These results are utilized in the consideration of heat and mass transfer phenomena at a fluid-solid interface. The development of surface renewal theory is presented and applied to the description of heat and mass transfer phenomena. *Prep. BS degree in Chemical Engineering.*

CHE 3501 Transport Phenomena I 2QH
Winter Quarter, As Announced

CHE 3501 and CHE 3502 cover the same material with the same prerequisites as CHE 3500, but in two 2QH courses.

CHE 3502 Transport Phenomena II 2QH
Spring Quarter, As Announced

Continuation of CHE 3501. *Prep. CHE 3501.*

CHE 3510 Modeling and Simulation of Chemical Process 4QH
(formerly 04.837) Winter Quarter, Alternating Years

Use of special purpose and general purpose computer programs in solving the steady-state material and energy balances of chemical processes. Course includes related background material which may be applied to these computer programs such as convergence acceleration for calculations involving recycle streams, tearing recycle streams for iteration on minimum number of streams and minimum number of parameters, and algorithms for design variable selection. *Prep. Graduate standing in Chemical Engineering.*

CHE 3511 Modeling and Simulation of Chemical Process I 2QH
Winter Quarter, As Announced

CHE 3511 and CHE 3512 cover the same material with the same prerequisites as CHE 3510, but in two 2QH courses.

CHE 3512 Modeling and Simulation of Chemical Process II 2QH
Spring Quarter, As Announced

Continuation of CHE 3511. *Prep. CHE 3511.*

CHE 3520 Computer Process Control 4QH
(formerly 04.830) Winter Quarter, Alternating Years

Computer control hardware and software. Z-transform, pulse transfer functions, and data holds. Open and closed-loop response and design of sampled-data systems. Computer control algorithms. Digital simulation of sampled data systems. *Prep. Graduate standing in Chemical Engineering or permission.*

CHE 3521 Computer Process Control I 2QH
Winter Quarter, As Announced

CHE 3521 and CHE 3522 cover the same material with the same prerequisites as CHE 3520, but in two 2QH courses.

CHE 3522 Computer Process Control II 2QH
Spring Quarter, As Announced

Continuation of CHE 3521. *Prep. CHE 3521.*

CHE 3530 Advanced Management Techniques in the Chemical Industry 4QH
(formerly 04.840) Fall Quarter, Alternating Years

Management techniques applied to the chemical industry. Special attention to management of research organizations and to management of engineering services, such as design, computer, and related activities. *Prep. Graduate standing.*

CHE 3531 Advanced Management Techniques in the Chemical Industry I 2QH
Fall Quarter, As Announced

CHE 3531 and CHE 3532 cover the same material with the same prerequisites as CHE 3530, but in two 2QH courses.

CHE 3532 Advanced Management Techniques in the Chemical Industry II 2QH

Winter Quarter, As Announced
Continuation of CHE 3531. *Prep. CHE 3531.*

CHE 3540 Advanced Process Design Concepts 4QH
(formerly 04.845) Spring Quarter, Alternating Years

This course stresses techniques and approaches used in the development of new or improved processes. Topics include establishment of process bases, use of process simulators in design, optimization and evaluation of alternatives, and preliminary equipment design and cost estimating techniques. *Prep. BS degree in Chemical Engineering.*

CHE 3541 Advanced Process Design Concepts I 2QH

Fall Quarter, As Announced
CHE 3541 and CHE 3542 cover the same material with the same prerequisites as CHE 3540, but in two 2QH courses.

CHE 3542 Advanced Process Design Concepts II 2QH

Winter Quarter, As Announced
Continuation of CHE 3541. *Prep. CHE 3541.*

CHE 3543 Advanced Plant Design Concepts II 2QH

Spring Quarter, As Announced
Modern approaches to plant design: computer-oriented design, analysis and simulation of chemical processes, use of strategy decision making in design, advanced scheduling and planning techniques. *Prep. BS degree in Chemical Engineering.*

CHE 3560 Fluid Mechanics 4QH
(formerly 04.974) Fall Quarter, Alternating Years

Discussion of statics, kinematics, and stress concepts associated with fluids. Formation of the general equations of motion with application to laminar and turbulent flow. Topics on boundary layer theory and compressible flow are included. *Prep. BS degree in Chemical Engineering.*

CHE 3561 Fluid Mechanics I 2QH
Fall Quarter, As Announced

CHE 3561 and CHE 3562 cover the same material with the same prerequisites as CHE 3560, but in two 2QH courses.

CHE 3562 Fluid Mechanics II 2QH
Winter Quarter, As Announced

Continuation of CHE 3561. *Prep. CHE 3561.*

CHE 3600 Polymer Science 4QH
(formerly 04.870) Fall Quarter, Alternating Years

Basic concepts of polymers, thermodynamics of polymer solutions and measurement of molecular weight. Physical and chemical testing of polymers. Crystallinity in polymers and rheology of poly-

mers. Physical and chemical properties of polymers. Mechanisms and conditions for polymerization of polymers including step-reaction, addition and copolymerization. Discussion of carbon-chain polymers, fibers and fiber technology. *Prep. BS degree in Chemical Engineering or Chemistry.*

CHE 3601 Polymer Science I **2QH**
Fall Quarter, As Announced

CHE 3601 and CHE 3602 cover the same material with the same prerequisites as CHE 3600, but in two 2QH courses.

CHE 3602 Polymer Science II **2QH**
Winter Quarter, As Announced

Continuation of CHE 3601. *Prep. CHE 3601.*

CHE 3620 Principles of Polymerization **4QH**
(formerly 04.872) Fall Quarter, Alternating Years

Introduction to polymers and polymer properties. Mechanisms of polymerization including step polymerization, radical-chain polymerization, emulsion polymerization, ionic-chain polymerization, chain copolymerization and ring-opening polymerization. Stereo chemistry of polymerization and synthetic reactions of polymers. Applications to reactor design of industrially important polymers. *Prep. Graduate standing in Chemical Engineering.*

CHE 3621 Principles of Polymerization I **2QH**
Fall Quarter, As Announced

CHE 3621 and CHE 3622 cover the same material with the same prerequisites as CHE 3620, but in two 2QH courses.

CHE 3622 Principles of Polymerizations II **2QH**
Winter Quarter, As Announced

Continuation of CHE 3621. *Prep. CHE 3621.*

CHE 3630 Chemical Process Pollution Control **4QH**

(formerly 04.850) Spring Quarter, Alternating Years

Provides chemical engineering students with basic fundamentals for handling environmental problems in the chemical process industries. Water quality requirements and industrial waste characteristics; wastewater treatment processes applicable to environmental engineering; biological treatment processes and equipment; comprehensive design problems involving biological and tertiary treatment; the economics of water treatment and reuse. *Prep. Graduate standing in Chemical Engineering.*

CHE 3631 Chemical Process Pollution Control I **2QH**

Winter Quarter, As Announced
CHE 3631 and CHE 3632 cover the same material with the same prerequisites as CHE 3630, but in two 2QH courses.

CHE 3632 Chemical Process Pollution Control II **2QH**

Spring Quarter, As Announced
Continuation of CHE 3631. *Prep. CHE 3631.*

CHE 3660 Solar Energy Thermal Processes

(formerly 04.862) 2QH
Fall Quarter

Covers fundamental thermal processes involved in obtaining useful heat from flat-plate solar collectors. The components required in an active solar energy collection system are analyzed, and the economics of the system are considered. *Prep. BS degree.*

CHE 3663 Fundamentals of Polymer Processing **4QH**

(formerly 04.871) Winter Quarter, Alternating Years

Transport properties of polymer solutions and polymer melts. Modeling and design of polymer processing equipment. Flow models for processes involving heat, mass, and/or momentum transfer. Analysis of flow stability and elastic phenomena. Applications to the design of equipment for extrusion, calendering, coating, fiber spinning, tubular film blowing, injection molding and mixing. *Prep. Graduate standing in Chemical Engineering.*

CHE 3664 Fundamentals of Polymer Processing I **2QH**

Winter Quarter, As Announced
CHE 3664 and CHE 3665 cover the same material with the same prerequisites as CHE 3663, but in two 2QH courses.

CHE 3665 Fundamentals of Polymer Processing II **2QH**

Spring Quarter, As Announced
Continuation of CHE 3664. *Prep. CHE 3664.*

CHE 3670 Special Topics in Chemical Engineering **4QH**

(formerly 04.899) As Announced
Topics of interest to the staff member conducting this class are presented for advanced study. A student may not take more than one Special Topics course with any one instructor. *Prep. Permission of department staff.*

CHE 3671 Kinetics of Chemical Processes **2QH**

(formerly 04.891) Spring Quarter, Alternating Years

The theoretical foundations for the analysis of elementary chemical reaction rates, such as collision theory, particle dynamics, and transition state theory are presented. Consideration is given to the theory of monomolecular reactions and the effect of solvent and electrostatic forces on liquid phase reaction rates. Homogeneous catalysis and selected free-energy correlations are covered. *Prep. BS degree in Chemical Engineering.*

CHE 3672 Kinetics of Chemical Processes I **2QH**

Winter Quarter, As Announced
CHE 3672 and CHE 3673 cover the same material with the same prerequisites as CHE 3671, but in two 2QH courses.

CHE 3673 Kinetics of Chemical Processes II 2QH
Spring Quarter, As Announced
 Continuation of CHE 3672. *Prep. CHE 3672.*

CHE 3680 Corrosion Fundamentals 2QH
(formerly 04.821) As Announced
 Economic factors, basic theories, types, behaviors of specific systems, and protection against corrosion are studied. Wherever possible, engineering applications of the principles are emphasized. *Prep. BS degree.*

CHE 3690 Seminar 2QH
(formerly 04.990) Any Quarter
 Topics of an advanced nature are presented by staff, outside speakers, and students in the graduate program. This course must be attended by all master's degree candidates. *Prep. Graduate standing in Chemical Engineering.*

CHE 3796 DEng Continuation 0QH
Any Quarter

CHE 3798 Masters Thesis Continuation 0QH
(formerly 04.9X1) Any Quarter

CHE 3799 PhD Continuation 0QH
(formerly 04.9X4) Any Quarter

CHE 3801 Thesis (Master's degree) 10QH
(formerly 04.991) Any Quarter
 Analytical and/or experimental work conducted under the supervision of the department. *Prep. Graduate standing in Chemical Engineering.*

CHE 3880 Thesis (PhD Degree) 0QH
(formerly 04.995) Any Quarter
 Theoretical and experimental work conducted under the supervision of the department. *Prep. Admission to doctoral program in Chemical Engineering.*

CHE 3885 Thesis (DEng Degree) 0QH
(formerly 04.996) Any Quarter
 Theoretical and experimental work conducted under the supervision of the department. *Prep. Admission to program in Chemical Engineering.*

Civil Engineering

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CIV 3131 Engineering Statistics I 2QH
(formerly 01.916) Fall Quarter
 The basic elements of probability theory and statistics and their use via the solution of various civil engineering problems encountered in fluid mechanics, construction management, structures, transportation. Probability of events, random variables and distributions, derived distributions, expectation, common probability models. *Prep. Undergraduate calculus.*

CIV 3132 Engineering Statistics II 2QH
(formerly 01.917) Winter Quarter
 Continuation of CIV 3131. Includes parameter estimation, confidence intervals, hypothesis testing, and linear statistical models. *Prep. CIV 3131.*

CIV 3141 Numerical Methods in Civil Engineering I 2QH
(formerly 01.888) Fall Quarter
 Introduction, errors in numerical analysis. Solution of nonlinear algebraic equations by direct and iterative methods. Introduction to matrix eigenvalue problems. Examples are drawn from structural mechanics. *Prep. Admission to the Graduate School of Engineering.*

CIV 3142 Numerical Methods in Civil Engineering II 2QH
(formerly 01.889) Winter Quarter
 Continuation of CIV 3141. Approximation of functions: interpolation, and least squares curve fit-

ting; orthogonal polynomials. Numerical differentiation and integration. Solution of ordinary and partial differential equations, and integral equations; discrete methods of solution of initial and boundary-value problems. Examples are drawn from structural mechanics, geotechnical engineering, hydrology and hydraulics. *Prep. CIV 3141.*

CIV 3151 Environmental Impact Statement Process I 2QH
(formerly 01.865) Fall Quarter
 This course provides a pragmatic introduction to the legal/regulatory framework that determines the content and format of environmental documents and presents an overview of the techniques used to identify and evaluate environmental impacts. *Prep. Admission to Graduate School of Engineering.*

CIV 3152 Environmental Impact Statement Process II 2QH
(formerly 01.866) Winter Quarter
 This course supplements the information on procedures and analysis encompassed in CIV 3151 by setting forth state-of-the-art techniques for quantification of environmental effects and development of measures to mitigate identified adverse impacts. *Prep. CIV 3151.*

CIV 3155 Technology Assessment 2QH
(formerly 01.988) Winter Quarter
Classical views of technology. History and definition of technology assessment. Individual, environmental and societal impacts of technologies. Technological externalities. Risks and the determination of safety. Policy options for dealing with technological problems. Case studies. *Prep. Admission to the Graduate School of Engineering and consent of instructor.*

CIV 3161 System Analysis I 2QH
(formerly 01.807) Fall Quarter
Application of linear optimization models to various civil engineering problems: the simplex method, sensitivity analysis, transportation problem, transshipment problem, shortest path problem. *Prep. Admission to Graduate School of Engineering.*

CIV 3162 Systems Analysis II 2QH
(formerly 01.808) Winter Quarter
Further application of systems analysis techniques to civil engineering problems: dynamic programming, linear regression, model estimation, queuing theory, project evaluation. *Prep. CIV 3162 and CIV 3131; to be taken concurrently with CIV 3132.*

CIV 3163 Systems Analysis III 2QH
(formerly 01.809) Spring Quarter
Further application of techniques and approaches presented in CIV 3161 and CIV 3162. New topics to be presented include integer programming, non-linear programming, simulation, decision analysis. Other topics may be added according to interest, as time allows. Aim will be to help prepare students to complete a term project employing numerous techniques of systems analysis. *Prep. CIV 3163.*

CIV 3231 Construction Management I 2QH
(formerly 01.821) Fall Quarter
This course treats cost estimating, including a description of computerized cost estimating systems; duration estimating, considering work analysis techniques; value engineering as a concept and its effect on the construction industry; and specifications, including the use and importance of computerized Specification Writing Systems. *Prep. Admission to Graduate School of Engineering.*

CIV 3232 Construction Management II 2QH
(formerly 01.822) Winter Quarter
This course contains treatment of the application of scheduling methods to the control of construction activities including resource allocation, quality control, cash flow progress reporting, and the effects of change orders. *Prep. CIV 3231.*

CIV 3237 Construction Methods and Equipment I 2QH
(formerly 01.830) Fall Quarter
This course treats typical approaches to construction in a selection of application areas such as

steel and concrete structures, hydraulic and port facilities, horizontal construction and the like. *Prep. Admission to Graduate School of Engineering.*

CIV 3238 Construction Methods and Equipment II 2QH
(formerly 01.831) Winter Quarter
This course is a continuation of CIV 3237, treating additional areas of construction. *Prep. CIV 3237.*

CIV 3241 Legal Aspects of Civil Engineering I 2QH
(formerly 01.832) Fall Quarter
A presentation of United States and international legal systems and theories necessary for the comprehension of business and contractual liabilities, rights and obligations in the engineering field. *Prep. Admission to the Graduate School of Engineering.*

CIV 3242 Legal Aspects of Civil Engineering II 2QH
(formerly 01.833) Winter Quarter
This course deals with the description and evaluation of various types of construction contracts, procedures and formats for submitting bids, filing claims, and legal steps to avoid liabilities, utilizing the principles learned in CIV 3241. *Prep. CIV 3241.*

CIV 3245 Construction Seminar 2QH
(formerly 01.827) Spring Quarter
This course is a reading and discussion course centering on recent research publications in Construction Engineering. *Prep. Limited to Construction Management Program majors; to be taken in final spring quarter.*

CIV 3310 Environmental Chemistry I 2QH
(formerly 01.920) Fall Quarter
A review of basic chemistry is followed by a discussion of the equilibrium chemistry of homogeneous and heterogeneous systems with applications in environmental engineering. The physical and chemical properties of water are studied, as are acidity, alkalinity, hardness, and water softening. Topics in receiving water quality and disinfection are included. *Prep. Two quarters of general chemistry.*

CIV 3311 Environmental Chemistry II 2QH
(formerly 01.921) Winter Quarter
Continuation of CIV 3310, including the basic principles of chemical thermodynamics, electrochemistry, kinetics, organic chemistry, biochemistry, and nuclear chemistry as they relate to environmental engineering. Colloidal chemistry and coagulation are discussed as are fundamental water quality parameters such as BOD, COD, and TOC. *Prep. CIV 3310; to be taken concurrently with CIV 3325.*

CIV 3312 Environmental Chemistry I and II 4QH
(formerly 01.923) Fall Quarter
This course embodies the material in CIV 3310 and CIV 3311. *Prep. Two quarters of general chemistry.*

CIV 3315 Water and Wastewater Treatment I **2QH**
(formerly 01.910) Fall Quarter
 Water quality, water impurities and effects, the theory and practice of water treatment, and the elements of design of water treatment works including intake facilities, wells, coagulation, sedimentation, filtration, softening, iron and manganese removal, disinfection and fluoridation. *Prep. Undergraduate fluid mechanics and CIV 3311.*

CIV 3316 Water and Wastewater Treatment II **2QH**
(formerly 01.911) Winter Quarter
 Waste characteristics, the theory and practice of wastewater treatment and disposal, and the elements of design of primary and secondary treatment works, including screening, grit removal, sedimentation, biological treatment processes, sludge digestion and disposal, stabilization ponds, and disinfection. *Prep. CIV 3315.*

CIV 3317 Water and Wastewater Treatment III **2QH**
(formerly 01.912) Winter and Spring Quarters
 Desalination, advanced wastewater treatment, land treatment, effluent disposal and reuse, small alternative wastewater systems, and other special problems in water and wastewater characteristics and treatment, including corrosion control, and application and storage of chemicals. *Prep. CIV 3316 or CIV 3318.*

CIV 3318 Water and Wastewater Treatment I and II **4QH**
(formerly 01.914) Fall Quarter
 This course embodies the material in CIV 3315 and CIV 3316. *Prep. Undergraduate fluid mechanics; to be taken concurrently with CIV 3312.*

CIV 3320 Environmental Microbiology **2QH**
(formerly 01.922) Winter and Spring Quarters
 A study of microbiology with emphasis on environmental engineering applications. The course includes cell structure, nutrition, morphology, growth, reproduction, and metabolism of microorganisms of environmental significance. Effects of environmental factors including inhibition, killing, and natural habitats are discussed. In addition, anaerobic digestion and eutrophication are covered. *Prep. CIV 3311; to be taken concurrently with CIV 3326.*

CIV 3325 Environmental Analysis I **2QH**
(formerly 01.930) Winter Quarter
 A laboratory course for the analytical evaluation of environmental conditions. Included are coagulation studies, chlorine demand determination, and the use of colorimetric spectroscopy. Interpretation of analytical results for practical applications is also stressed. *Prep. CIV 3310; to be taken concurrently with CIV 3311.*

CIV 3326 Environmental Analysis II **2QH**
(formerly 01.931) Spring Quarter
 Laboratory analyses are continued with emphasis on the chemical and biological analyses associated with wastewater treatment methods. Nitrogen determinations are included. Gas chromatography and atomic absorption spectroscopy are used for trace analyses of organics and metals. *Prep. to be taken concurrently with CIV 3312.*

CIV 3327 Environmental Analysis I and II **4QH**
(formerly 01.933) Fall Quarter
 This course embodies the material in CIV 3325 and CIV 3326. *Prep. to be taken concurrently with CIV 3312.*

CIV 3341 Industrial Waste Disposal **2QH**
(formerly 01.913) Fall and Spring Quarters
 Evaluation of industrial waste problems and development of process design for the required treatment facilities; study of various manufacturing processes and their wastewater problems; industrial waste survey techniques; characteristics of industrial wastes; evaluation of hazardous materials; waste reduction methods; physical, chemical, biological and advanced treatment methods; industrial wastewaters and disposal and treatment of industrial solids and liquids. *Prep. CIV 3311 and CIV 3317.*

CIV 3343 Unit Operations in Environmental Engineering I **2QH**
(formerly 01.935) Winter Quarter
 Laboratory scale unit operations illustrating the physical, chemical and biological principles involved in water and wastewater treatment. The aim is to obtain criteria for system design. Topics include disinfection, water softening, sedimentation, chemical coagulation, and ion exchange. *Prep. CIV 3317 and CIV 3326.*

CIV 3344 Unit Operations in Environmental Engineering II **2QH**
(formerly 01.936) Spring Quarter
 Continuation of CIV 3343. Topics include biodegradability studies using activated sludge, fixed-film reactors, anaerobic digestion, vacuum filtration, and chemical-physical processes involved in wastewater treatment. A comprehensive evaluation of each unit process is required in a report from each student. *Prep. CIV 3343.*

CIV 3345 Unit Operations in Environmental Engineering I and II **4QH**
(formerly 01.938) Spring Quarter
 This course embodies the material in CIV 3343 and CIV 3344. *Prep. CIV 3317 and CIV 3326 or CIV 3327.*

CIV 3348 Stream Sanitation **2QH**
(formerly 01.954) Winter Quarter
 Analysis of the fate and effects of discharge of conservative and nonconservative pollutants in surface receiving waters and groundwaters.

Topics include BOD and oxygen relationships in streams, eutrophication and general water quality improvement techniques. *Prep. CIV 3310.*

CIV 3351 Open Channel Flow I 2QH
(formerly 01.902) **Fall Quarter**

Open channel flow classification; energy and momentum principles; uniform flow calculations; design of channels for uniform flow; channel transitions; gradually varied flow; surface profile computations; spatially varied flow. *Prep. Undergraduate fluid mechanics and hydraulic engineering.*

CIV 3352 Open Channel Flow II 2QH
(formerly 01.903) **Winter Quarter**

Rapidly varied flow, hydraulic jump and its applications; flow through nonprismatic channel sections; flow in channels of nonlinear alignment, wave action; unsteady flow, dynamic equations; wave propagation; flood routing in rivers. *Prep. CIV 3351.*

CIV 3355 Hydrology I 2QH
(formerly 01.908) **Winter Quarter**

Elements of the hydrologic cycle, precipitation, evaporation, streamflow, groundwater; water balance equation for watersheds; streamflow hydrographs, unit hydrographs, hydrographs of overland flow; relation between precipitation and runoff; hydrologic and hydraulic routings, linear reservoirs routing. *Prep. CIV 3131 and undergraduate fluid mechanics and hydraulic engineering.*

CIV 3356 Hydrology II 2QH
(formerly 01.909) **Spring Quarter**

Deterministic hydrologic models; probability in hydrology; stochastic hydrology, generation of data, Markov chain series; flood forecasting; applications of hydrology and design considerations. *Prep. CIV 3132 and CIV 3355.*

CIV 3358 Flow Through Porous Media 2QH
(formerly 01.924) **Fall Quarter, Alternate Years**

Groundwater uses; properties of porous media; infiltration, saturated and unsaturated zones, soil water interactions; types of aquifers; Darcy's law, Dupuit-Forchermier's assumption, groundwater flow equations, steady and unsteady cases; steady state seepage problems, method of flow nets; dispersion of groundwater, quality and contamination of groundwater. *Prep. Undergraduate fluid mechanics and hydraulic engineering.*

CIV 3360 Groundwater and Seepage 2QH
(formerly 01.925) **Winter Quarter, Alternate Years**

Hydraulics of wells, steady and transient flow equations, pumping tests, multiple well systems, methods of images; superposition, leaky aquifers, salt-water intrusion, static equilibrium and hydrodynamic equilibrium, control of saline water intrusion; numerical and experimental methods, physical models, analog models, finite difference solution, introduction to the method of finite elements. *Prep. CIV 3358.*

CIV 3363 Hydraulic Structures I 2QH

(formerly 01.963) **Fall Quarter, Alternate Years**
Reservoirs, characteristics, capacity, sedimentation, waves and floods; forces on dams; types of dams; gravity dams; earth dams; arch dams; cofferdams; turbines. *Prep. Admission to Graduate School of Engineering.*

CIV 3364 Hydraulic Structures II 2QH
(formerly 01.964) **Winter Quarter, Alternate Years**

Intake structures; outlet structures, spillways; tunnels; canals; offshore protection. *Prep. CIV 3363.*

CIV 3367 Water Resources Planning 2QH
(formerly 01.965) **Spring Quarter, Alternate Years**

The nature of water resources projects (sociopolitical, legal); water resources planning objectives (economic, cost, benefit); problems in water resources engineering (development, design, operational, recapitulation); introduction to linear and dynamic programming; simulation methods; case studies. *Prep. CIV 3141 and CIV 3355.*

CIV 3370 Air Pollution Engineering 2QH
(formerly 01.950) **Winter Quarter**

Theory and practice related to engineering management of air resources; applications of models for the atmospheric dispersion of pollutants; analysis of control systems for gaseous and particulate emissions utilizing dry collection, wet collection, absorption, and catalytic processes. Discussion of source control evaluation and air quality standards. Course CIV 3374 is recommended. *Prep. Admission to Graduate School.*

CIV 3372 Air Sampling and Analysis 2QH
(formerly 01.955) **Spring Quarter**

A laboratory course in air pollution measurements utilizing physical, chemical and instrumental methods and calibration and use of sampling equipment for gaseous and particulate pollutants. Identification and quantitative measurements of pollutants are performed utilizing microscopy, spectrophotometry, gas chromatography, and atomic absorption spectroscopy. *Prep. CIV 3370.*

CIV 3374 Air Pollution Science 2QH
(formerly 01.957) **Fall Quarter**

Biological and chemical aspects of air pollution with emphasis on the toxicological aspects of the environment, physiological effects of aerosols, analysis of organic and inorganic constituents of the atmosphere and rationale for establishment of air quality criteria and standards. Note: This course is open to non-engineering as well as to engineering graduate students. *Prep. Consent of the department and instructor.*

CIV 3376 Industrial Hygiene 2QH
(formerly 01.952) **Winter Quarter**

Characterization and control of industrial problems associated with noise, heat and ventilation. Physical and biological aspects of environmental stress are discussed. Emphasis is placed on the

application of engineering principles to the design of control systems. Evaluation procedures for control effectiveness are reviewed. *Prep. Admission to Graduate School of Engineering.*

CIV 3378 Environmental Planning and Management **2QH**
(formerly 01.980) **Fall Quarter**

Planning and operation, and management of specific environmental systems, such as collection systems; solids separators, combined systems control, sewer flushing, deposition loadings with least-squared applications, and case studies in optimal design of treatment plants with variable input. *Prep. Admission to Graduate School of Engineering.*

CIV 3380 Environmental Protection **2QH**
(formerly 01.985) **Spring Quarter**

Environmental quality and its effects on health, comfort, aesthetics, balance of ecosystems and renewable resources; interaction of the water-land-air complex, vector control, food protection, ionizing radiation, other radiation, and the energies of heat and sound. *Prep. Admission to Graduate School of Engineering.*

CIV 3384 Solid Waste Management **2QH**
(formerly 01.945) **Fall Quarter**

Basic solid waste management for engineering and science students covering storage, collection practices, sanitary landfill principles, incineration practices and reclamation possibilities. *Prep. Admission to Graduate School of Engineering.*

CIV 3386 Hazardous Waste Practices **2QH**
(formerly 01.946) **Spring Quarter**

An investigation of hazardous waste management practices including: identification, storage, transport, treatment processes, incineration, recycling, reuse, chemical landfills and groundwater contamination. *Prep. CIV 3311 or CIV 3312.*

CIV 3388 Design of Environmental Systems I **2QH**
(formerly 01.971) **Winter Quarter**

Examination of analysis and design of environmental control systems using computer-based models as a tool. Development of components of a treatment system model applicable to simulate process using accepted mathematical relationships. Optimization of various combinations of systems on the basis of economics and/or performance. Development of sensitivity tests for fluctuation in such items as labor or power units costs. *Prep. CIV 3317 and general knowledge of a computer language (BASIC or FORTRAN).*

CIV 3389 Design of Environmental Systems II **2QH**
(formerly 01.972) **Spring Quarter**

Fundamental design concepts of complete systems for environmental control, including water treatment; wastewater disposal, air quality control, and solid waste disposal; evaluation of econo-

mic alternatives for environmental quality control; discussion of actual engineering reports and designs will include considerations of the logic and conclusions. *Prep. CIV 3388.*

CIV 3392 Seminar-Environmental Engineering **2QH**
(formerly 01.994) **Fall Quarter**

Discussion by professional engineers and scientists, faculty, and graduate students on subjects in the area of environmental engineering and science. Open to all students actively working on either a Master's Report or Thesis. *Prep. Consent of the instructor.*

CIV 3410 Soil Mechanics I **2QH**
(formerly 01.871) **Fall Quarter**

Phase relationships and index properties, permeability, capillarity, effective stress concept, porous media flow, stress distribution, stress path concept, 1-D settlement analysis. *Prep. Undergraduate course in soil mechanics.*

CIV 3411 Soil Mechanics II **2QH**
(formerly 01.872) **Winter Quarter**

Continuation of CIV 3410. Consolidation theory, 3-D settlement analysis, shear strength properties of soils, stress path analysis. *Prep. CIV 3410.*

CIV 3412 Soil Mechanics III **2QH**
(formerly 01.873) **Spring Quarter**

Continuation of CIV 3411. Stability of open cuts and natural slopes; numerical analysis and computer applications to stability, seepage, consolidation, and deformation problems, laboratory testing; field instrumentation; special topics. *Prep. CIV 3411 or CIV 3413.*

CIV 3413 Soil Mechanics I and II **4QH**
(formerly 01.877) **Fall Quarter**

Embodies the material in CIV 3410 and CIV 3411. *Prep. Undergraduate course in soil mechanics.*

CIV 3420 Foundation Engineering I **2QH**
(formerly 01.874) **Fall Quarter, Alternate Years**

Lateral earth pressure theory; retaining wall design; anchored bulkheads; braced cofferdams, dewatering, observational approach to design. *Prep. CIV 3411.*

CIV 3421 Foundation Engineering II **2QH**
(formerly 01.875) **Winter Quarter, Alternate Years**

Bearing capacity, design of shallow foundations, site improvement (preloading, deep densification), case studies of foundation performance. *Prep. CIV 3420.*

CIV 3422 Foundation Engineering III **2QH**
(formerly 01.876) **Spring Quarter, Alternate Years**

Pile foundations, caissons, selection of foundation scheme; case studies. *Prep. CIV 3421.*

CIV 3423 Foundation Engineering I and II **4QH**
(formerly 01.878) **Spring Quarter**

Embodies the course content offered in CIV 3420 and CIV 3421. *Prep. CIV 3411 or CIV 3413.*

CIV 3430 Soil-Structure Interaction 4QH
(formerly 01.870) **Winter Quarter**

Introduction to pile foundations; beam on elastic foundations; deformations of axially and laterally loaded single piles and pile groups using available computer software; pile load tests; case histories. *Prep. CIV 341I or CIV 3413.*

CIV 3440 Experimental Soil Mechanics 4QH
(formerly 01.879) **Spring Quarter**

Laboratory evaluation of engineering properties of soils with emphasis on permeability, compressibility and strength. Introduction to model analysis of static and dynamic behavior of soils. *Prep. CIV 3411 or CIV 3413.*

CIV 3450 Engineering Geology 2QH
(formerly 01.882) **Fall Quarter, Alternate Years**

Review of minerals, selected topics in historical and structural geology related to engineering geology; origin and occurrence of various rock types, geologic structures, faulting and joint systems; weathering of rock and weathering products, glaciation, geologic mapping and environmental aspects. *Prep. Undergraduate course in geology.*

CIV 3460 Rock Mechanics I 2QH
(formerly 01.884) **Winter Quarter, Alternate Years**

Interrelationship with other disciplines; index properties; classification systems; laboratory tests; state of stress and stress distribution. *Prep. CIV 3450.*

CIV 3461 Rock Mechanics II 2QH
(formerly 01.885) **Spring Quarter, Alternate Years**

Behavior of rock under combined stresses; pore pressure effects; failure theories; in-situ deformation modulus and shear strength characteristics; field testing. *Prep. CIV 3460.*

CIV 3470 Soil Dynamics I 2QH
(formerly 01.886) **Fall Quarter**

Dynamic response analysis of one-degree-of-freedom systems, characteristics of earthquakes and resulting ground motions, response spectra, stress-strain behavior of soils during dynamic and repeated loading, laboratory and field determinations, wave propagation through elastic media, effect of local soil condition upon earthquake ground motions. *Prep. Admission to the Geotechnical Engineering Program.*

CIV 3471 Soil Dynamics II 2QH
(formerly 01.887) **Winter Quarter**

Dynamic response analysis of a single mass, multidegree-of-freedom systems; machine foundation design and analysis; soil-structure interaction, ground vibrations, sources and control; shear strength during repeated loading, liquefaction; dynamic analysis of retaining structures and slopes. *Prep. CIV 3470.*

CIV 3480 Seismic Design 2QH
(formerly 01.850) **Spring Quarter**

Earthquake considerations in building design process, dynamic analysis of multidegree-of-freedom elastic systems subjected to earthquake motions and cyclically applied forces, inelastic dynamic response analysis. Seismic provisions of building codes; soil-structure interaction. *Prep. CIV 3470.*

CIV 3485 Selected Topics In Earthquake Engineering 2QH
(formerly 01.851) **Spring Quarter**

Seismic hazard and seismic risk analysis; seismic design decision analysis; lifeline earthquake engineering; pipelines, liquid storage tanks, water distribution systems; earthquake analysis of earth dams and slopes; dynamic analysis of retaining walls and offshore facilities; dynamically loaded piles. *Prep. CIV 3470.*

CIV 3510 Advanced Structural Mechanics I 2QH
(formerly 01.841) **Fall Quarter**

Analysis of force equilibrium (stress), deformation/deplacement (strain), and force/deformation (Hooke's Law) for an elastic solid; compatibility; governing equations for complete and approximate elasticity solution. Plane stress solution for narrow rectangular beams. Torsion, Saint Venant's theory, membrane analogy, rectangular sections, thin open and closed sections. Introduction to bending of thin plates. *Prep. Undergraduate structural mechanics and structural analysis.*

CIV 3511 Advanced Structural Mechanics II 2QH
(formerly 01.842) **Winter Quarter**

Consistent models for the mechanics of simple structural elements: axial, bending, plane stress, and the like. Equilibrium, geometry of deformation, and force/deformation as the governing relations of all structural elements. Work and energy principles: virtual displacement, virtual forces, minimum potential energy, minimum complementary energy, introduction to variational ideas, Rayleigh-Ritz method. *Prep. CIV 3510.*

CIV 3512 Advanced Structural Mechanics I and II 4QH
(formerly 01.847) **Fall Quarter**

This course embodies the material in CIV 3510 and CIV 3511. However, more emphasis will be placed on variational principles. *Prep. Undergraduate structural mechanics and structural analysis.*

CIV 3520 Engineering Materials I 2QH
(formerly 01.824) **Winter Quarter**

Mechanical, microstructural, physical and chemical properties of cements and concretes and their roles in structures, pavements, bridge decks, repair and rehabilitation will be covered. Different concretes such as expansive cement concrete, sulfate-resistant concrete, sulfur concrete and fiber-reinforced concrete will be introduced. *Prep. Admission to Graduate School.*

CIV 3521 Engineering Materials II **2QH**
(formerly 01.825) **Spring Quarter**
 Topics include the elastic, plastic and viscoelastic properties of solids and composites; introduction to fracture mechanics and fatigue. *Prep. Admission to Graduate School.*

CIV 3525 Stability **2QH**
(formerly 01.859) **Spring Quarter**
 Prediction of the buckling loads in columns, behavior of beam columns, use of numerical methods to compute the buckling loads of non-prismatic members, buckling of plates. *Prep. CIV 3510 and CIV 3511.*

CIV 3530 Finite-Element Analysis of Structures I **2QH**
(formerly 01.843) **Spring Quarter**
 Introduction to finite-element method for structural analysis. Overview of direct stiffness method. Formulation of element stiffness matrices by direct use of elasticity relations and by energy methods for simple elements; axial, bending, plane stress, and plane strain; transformation of coordinate systems; lumping work equivalent loads; bounds on the error solution. Plate bending. Use of finite-element computer programs. *Prep. CIV 3511.*

CIV 3531 Finite-Element Analysis of Structures II **2QH**
(formerly 01.844) **Fall Quarter**
 Additional applications of the finite-element method. *Prep. CIV 3530.*

CIV 3532 Finite-Element Analysis of Structures I and II **4QH**
(formerly 01.856) **Winter Quarter**
 Embodies the course content offered in CIV 3530 and CIV 3531. *Prep. CIV 3512 or CIV 3511.*

CIV 3535 Advanced Structural Analysis **4QH**
(formerly 01.845) **Fall Quarter**
 Offered days. Formulation and solution of structural problems with primary application to member systems (trusses, frames, curved members), matrix formulation of flexibility and stiffness methods; geometrically nonlinear behavior. *Prep. Admission to the Graduate School of Engineering.*

CIV 3540 Optimization in Structural Engineering **4QH**
(formerly 01.852) **Spring Quarter**
 Unconstrained and constrained optimization; Kuhn-Tucker condition; Sequential Unconstrained Minimization Technique (SUMT); design sensitivity analysis; Gradient Projection Method (GRP). Although problem formulation is quite general, emphasis will be on the practical structural application where the displacement (stiffness) method is used as part of the structural-synthesis algorithm. Knowledge of FORTRAN assumed. *Prep. CIV 3535.*

CIV 3545 Structural Dynamics **4QH**
(formerly 01.857) **Fall Quarter**
 Single degree of freedom structural systems, free vibration, forced vibration, Duhamel integral, time step integration, multidegree-of-freedom structural systems, model analysis, damping, response spectra, nonlinear systems, earthquake ground motions. *Prep. concurrently with CIV 3535.*

CIV 3550 Numerical Methods In Engineering Analysis **4QH**
(formerly 01.890) **Winter Quarter**
 Finite elements and finite differences methods for analysis of linear and nonlinear problems in solid, structural, and fluid mechanics. Computer-based numerical solutions in statics and dynamics (model analysis and direct integration). Eigensolution algorithms. Applications: forced vibration analysis, earthquakes, offshore, structural analysis. *Prep. CIV 3535 and CIV 3545.*

CIV 3560 Concrete Structures I **2QH**
(formerly 01.853) **Fall Quarter**
 Fundamentals of prestressing; design of prestressed concrete beams for flexure and shear; design of end blocks; load balancing method for the analysis of indeterminate prestressed structures; column design. *Prep. Undergraduate Reinforced Concrete Design and Structural Analysis.*

CIV 3561 Concrete Structures II **2QH**
(formerly 01.854) **Winter Quarter**
 Design of two-way slabs by the equivalent frame method; yield line theory; prestressing of slabs; the strip method; and introduction to folded plate design. *Prep. Undergraduate Reinforced Concrete Design and Structural Analysis.*

CIV 3562 Concrete Structures III **2QH**
(formerly 01.855) **Spring Quarter**
 Additional topics of folded plate design, design of thin shelled structures including hyperbolic paraboloids and shells of revolution. *Prep. CIV 3561.*

CIV 3570 Advanced Steel Design I **2QH**
(formerly 01.861) **Fall Quarter**
 An advanced course in elastic design in structural steel. Design problems involving braced and rigid frame structures subject to gravity, wind and seismic loads are considered. *Prep. Undergraduate Steel Design and Structural Analysis.*

CIV 3571 Advanced Steel Design II **2QH**
(formerly 01.862) **Winter Quarter**
 An advanced course in analysis and design in structural steel with emphasis on plastic behavior including rigid frame buildings and braced multistory frame buildings. *Prep. Undergraduate Steel Design and Structural Analysis.*

CIV 3572 Advanced Steel Design III **2QH**
(formerly 01.863) **Spring Quarter**
 Advanced problems in elastic and plastic design of structural steel. Topics include curved girders, cable supported structures, fatigue considera-

tions, and composite sections with steel deck. *Prep. Undergraduate Steel Design and Structural Analysis.*

CIV 3580 Computer-Aided Structural Design **4QH**

(formerly 01.848) **Winter Quarter**

General characteristics of computer aided design software, development of software for the solution of typical structural steel and reinforced concrete design problems. *Prep. CIV 3535.*

CIV 3585 Marine Structures **4QH**

(formerly 01.846) **Spring Quarter**

This course covers the behavior of marine structures from the materials and structural analysis/design considerations. The first part covers the behaviors and properties of different materials in the marine environment. The second part covers the analysis/design aspects of these structures subjected to different environmental forces such as ice and ship impacts, wind and earthquakes. *Prep. CIV 3550 and CIV 3520.*

CIV 3610 Urban Public Transportation **2QH**

(formerly 01.811) **Fall Quarter**

Analysis and planning of public transportation systems, including bus, subway, commuter rail, and paratransit; performance prediction; service evaluation and efficiency control measure; demand prediction; institutional and economic issues. *Prep. Admission to Graduate School.*

CIV 3620 Traffic Flow Theory I **2QH**

(formerly 01.813) **Winter Quarter**

Statistical methods in traffic flow theory, probability models, hypothesis testing and its use, queuing theory, and simulation techniques. *Prep. Appropriate courses in calculus and statistics and permission of instructor.*

CIV 3621 Traffic Flow Theory II **2QH**

(formerly 01.814) **Spring Quarter**

Continuation of CIV 3620. Deterministic methods in traffic flow theory, car following models, various methods of determination of capacity and level of service, computer applications. *Prep. CIV 3620.*

CIV 3630 Traffic Engineering **2QH**

(formerly 01.817) **Spring Quarter**

Measurement of traffic characteristics and system performance; theory of traffic flow and analytical techniques; systems hardware design and evaluation; current concerns of energy, environmental, and urban amenity impacts; computer applications and institutional characteristics. *Prep. Admission to Graduate School.*

CIV 3635 Transportation Engineering **2QH**

(formerly 01.820) **Winter Quarter**

Description and evaluation of different modes of transportation existing and proposed; their performance and cost characteristics; design, performance, and selection criteria for vehicles and roadbeds. *Prep. Admission to Graduate School.*

CIV 3640 Theory and Practice of Transportation Planning I **2QH**

(formerly 01.835) **Fall Quarter**

Establishments of goals, objectives and criteria; the current planning framework; examination of performance characteristics of transportation systems, including public and private modes on land, water, and airways. *Prep. Admission to Graduate School.*

CIV 3641 Theory and Practice of Transportation Planning II **2QH**

(formerly 01.836) **Fall Quarter**

Continuation of CIV 3640. Transportation demand modeling from regional economic analysis to traffic and public transportation network assignment; technical and economic evaluation; current issues, including environmental assessment, transportation systems management, citizen participation, and planning in developing countries. *Prep. CIV 3640 to be taken previously or concurrently.*

CIV 3650 Urban Transportation Analysis I **2QH**

(formerly 01.815) **Winter Quarter**

Principles of analysis of urban transportation systems including travel demand equilibrium, performance and evaluation techniques using aggregate and disaggregate methods. *Prep. CIV 3641 and appropriate graduate statistics courses.*

CIV 3651 Urban Transportation Analysis II **2QH**

(formerly 01.816) **Spring Quarter**

Continuation of CIV 3650. Conceptualization, formulation, application, and evaluation of mathematical models utilized in urban transportation systems analysis; case studies of representative analyses. The objective of this course is to help prepare students to conceptualize, formulate, apply and evaluate appropriate mathematical modeling techniques in transportation. *Prep. CIV 3650.*

CIV 3798 Master's Thesis Continuation **0QH**

(formerly 01.9X1) **Any Quarter**

CIV 3799 PhD Continuation **0QH**

(formerly 01.9X4) **Any Quarter**

CIV 3830 Special Topic in Civil Engineering **2QH**

(formerly 01.992) **Fall, Winter, Spring Quarters**

Topics of interest to the staff member conducting this course are presented for advanced study. The course is initiated by the appropriate discipline committee and approved by the department. *Prep. Consent of the instructor.*

CIV 3835 Special Project in Civil Engineering **2QH**

(formerly 01.995) **Any Quarter**

An individual effort in an area selected by student and adviser and approved by the Departmental Discipline Committee resulting in a definitive report. *Prep. Permission of the department.*

CIV 3850 Master's Report **4QH**
(formerly 01.993) **Any Quarter**
 An individual effort consisting of laboratory and/or literature investigation and analysis or advanced design of a project in an area of civil engineering selected by student and adviser resulting in a definitive report. *Prep. Permission of the Civil Engineering Department.*

CIV 3860 Master's Thesis **8QH**
(formerly 01.991) **Any Quarter**
 Analytical and/or experimental research conducted by arrangement with and under the supervision of the department. *Prep. Permission of the Civil Engineering Department.*

CIV 3870 PhD Thesis 2QH
(formerly 01.997) **Any Quarter**
 Open to full-time doctoral students only. *Prep. Admission to doctoral program in Civil Engineering.*

Interdisciplinary Transportation

OINT 3798 Master's Thesis Continuation **0QH**
Any Quarter

OINT 3835 Special Project in Transportation **2QH**
(formerly 93.818) **Any Quarter**
 An individual effort in an area selected by student and adviser resulting in a definite report. *Prep. Permission of the Civil Engineering Department.*

OINT 3850 Master's Report in Transportation **4QH**
(formerly 93.819) **Any Quarter**
 An individual effort consisting of laboratory and/or literature investigation and analysis or advanced

design of a project in an area of transportation selected by student and adviser resulting in a definitive report. *Prep. Permission of the Civil Engineering Department.*

OINT 3860 Master's Thesis in Transportation **8QH**
(formerly 93.820) **Any Quarter**
 Analytical and/or experimental work conducted by arrangement with and under the supervision of the department. *Prep. Permission of the Civil Engineering Department.*

Electrical and Computer Engineering

Each course description includes information on the expected quarter in which classes are usually offered. The quarters listed are presented here for planning purposes; however, the Graduate School of Engineering cannot guarantee that all courses will be offered. Students must refer to the Graduate School of Engineering Quarterly Course Offering sheets to determine what courses are actually offered in any given quarter and at what day and time.

ECE 3100 Introduction to Circuits and Systems **4QH**
(formerly 03.846) **Fall Quarter**
 The circuit elements (R, L and C) are introduced. Kirchhoff's laws, Tellegen and Thevenin's theorem. Mesh and nodal analysis. Development of system function approach, Laplace and Fourier transform theory applied to circuit analysis. Sinusoidal steady-state, n-port network theory, and power and energy concepts. *Prep. Admission to Graduate School*

ECE 3101 Introduction to Electronics **4QH**
(formerly 03.847) **Winter Quarter**
 Characteristics of the theoretical physical junction. The Ebers-Moll model for bipolar junction transistors, characteristics of bipolar and field-effect devices, basic digital inverters and logic gates and various logic families. Use of transistors in the design of analog circuits. Biasing, linearized incremental models, load lines, signal flowgraphs,

frequency response and gain calculation for single and cascaded stages. *Prep. ECE 3100 or equivalent.*

ECE 3102 Introduction to Electromagnetic Field Theory **4QH**
(formerly 03.848) **Spring Quarter**
 Definition of scalar and vector fields; vector calculus; concepts of gradient, divergence, curl and the "del" operator; free-space electrostatics; the generalization of the Maxwell equations to the case of time-varying fields; Faraday induction law, wave equations and the plane wave solution. *Prep. ECE 3100 or equivalent.*

ECE 3103 Introduction to Digital Computers **4QH**
(formerly 03.849) **Fall Quarter**
 Basic components of digital systems and methods for their analysis and design, combinational and sequential circuits, integrated circuit logic fami-

lies and functional building blocks, registers, counters, decoders, multiplexers and memories. Data representation and coding techniques. Central processor alternatives; instruction formats, addressing modes, bus structures, arithmetic units, timing analysis and stacks. Algorithms for arithmetic operations with various data representations. *Prep. Admission to Graduate School.*

ECE 3104 Introduction to Communications

4QH

(formerly 03.850)

Spring Quarter

Review of system theory, convolution, Fourier series, Fourier integral, signal analysis, Fourier methods, correlation functions, density functions, power spectra, amplitude modulation, frequency modulation, phase modulation, sampling theory and digital modulation techniques. *Prep. ECE 3108 or equivalent.*

ECE 3105 Introduction to System Software I

2QH

Fall Quarter

A knowledge of PASCAL is helpful but not required for this course. Programming style considerations, software testing and software reliability. Data structures, including stacks, queues, linked lists, trees and graphs. The course emphasizes the use of PASCAL to implement typical system software routines that use the above data structures. Miscellaneous topics also discussed are modern system software considerations for multi-processor, array processor and graphic processor systems. *Prep. Admission to Graduate School.*

ECE 3106 Introduction to Systems Software II

2QH

Winter Quarter

An analysis of absolute and relocatable program translators. The topics covered are assemblers, disassemblers, macroassemblers, linkers, an overview of compilers, interpreters, simulators and emulators. For a typical lab assignment, the student will design and implement an absolute assembler for a very simplified instruction set. *Prep. ECE 3105.*

ECE 3107 Introduction to System Software III

2QH

Spring Quarter

An analysis of operating system structure and concepts. Memory management, fragmentation, paging, virtual memory, job and process scheduling, I/O management, file management. Operating system concepts for multiuser systems. Critical variables, race conditions, Dekker's algorithm, some sample multiuser routines. For a typical lab assignment, the student will write simulated paged memory management and process scheduling routines. *Prep. ECE 3106.*

ECE 3108 Introduction to Signals and Systems

4QH

Winter Quarter

Description and analysis of continuous and discrete signals and systems. Properties of systems. The input-output relationship of linear time-invariant systems. Discrete and continuous Fourier series and Fourier transforms. Laplace and z-transforms. Elements of filtering and sampling. *Prep. ECE 3100 or equivalent.*

ECE 3120 Power Circuit Analysis I

2QH

(formerly 03.925)

Fall Quarter

Fundamental concepts of single-phase and polyphase power systems; definitions of terms; use of per unit quantities; equivalent circuits of symmetrical 3-phase systems; introduction of symmetrical components; short circuits on systems with a single power source. *Prep. BSEE or ECE 3100 and ECE 3102.*

ECE 3130 Electrical Machinery Theory I

2QH

(formerly 03.940)

Fall Quarter

Review of magnetic circuit concepts and electromechanical energy-conversion principles; steady-state analysis of transformers, synchronous machines, and induction machines. *Prep. BSEE or ECE 3100 and ECE 3102.*

ECE 3200 Mathematical Methods in Computer Science

2QH

(formerly 03.8A1)

Fall Quarter

Algebraic concepts relevant to computer science; sets, relations, mapping, orderings, algebraic systems, Boolean algebras, groups, rings, finite fields, introduction to vector spaces and linear algebras over finite fields. *Prep. Admission to Graduate School.*

ECE 3211 Mathematical Methods in Electrical Engineering I

4QH

(formerly 03.823)

Fall and Winter Quarters

Linear algebraic equations; Gauss algorithm; linear operators in an n-dimensional vector space over infinite and finite fields; characteristic value problem, minimal polynomial; functions of a matrix; equivalence, congruence, and similarity transformation, canonical forms; polynomial matrices; Smith normal form; determinantal divisors; invariant polynomials, elementary divisors; companion and Jordan canonical matrices; decomposition of a vector space into invariant subspaces with respect to a linear operator. *Prep. Admission to Graduate School.*

ECE 3212 Mathematical Methods in Electrical Engineering I-A

2QH

Fall and Winter Quarters

ECE 3212 and ECE 3213 cover the same material with the same prerequisites as ECE 3211, but in two 2QH courses.

ECE 3213 Mathematical Methods in Electrical Engineering I-B **2QH****Winter and Spring Quarters**Continuation of ECE 3212. *Prep.* ECE 3212.**ECE 3221 Linear Systems Analysis** **4QH**
(formerly 03.827) **Fall and Winter Quarters**Introduction to the state variable theory of continuous and discrete linear systems. Standard canonical representations. The concept of state and the representation of interconnected systems. Linear spaces. The state equations and their solution. Stability. Introduction to the general control problem in terms of controllability and observability. *Prep.* ECE 3211, ECE 3108 or equivalent.**ECE 3222 Linear Systems Analysis A** **2QH**
(formerly 03.825) **Fall and Winter Quarters**

ECE 3222 and ECE 3223 cover the same material with the same prerequisites as ECE 3221, but in two 2QH courses.

ECE 3223 Linear Systems Analysis B **2QH**
(formerly 03.826) **Winter and Spring Quarters**Continuation of ECE 3222. *Prep.* ECE 3222.**ECE 3231 Mathematical Methods in Electrical Engineering II** **4QH****Summer Quarter**Complex variable theory; mapping by functions, definite and indefinite integrals, Cauchy integral formula, Laurent series, the residue theorem and branch points. Application of complex variable theory to Fourier theory, Hilbert transforms, and conformal transformations in the analysis of linear systems and in electrostatics; the Schwarz-Christoffel transformation, Poisson's integral formula and concept of analytical continuation. *Prep.* Admission to Graduate School.**ECE 3232 Mathematical Methods in Electrical Engineering II-A** **2QH**
(formerly 03.8C1) **Summer Quarter**

ECE 3232 and ECE 3233 cover the same material with the same prerequisites as ECE 3231, but in two 2QH courses.

ECE 3233 Mathematical Methods in Electrical Engineering II-B **2QH**
(formerly 03.8C2) **Summer Quarter**Continuation of ECE 3232. *Prep.* ECE 3232**ECE 3241 Applied Probability and Stochastic Processes** **4QH**
(formerly 03.902) **Fall and Winter Quarters**

Introductory probability, sample space and random variables, examples of discrete and continuous probability distribution functions, averages, moments and characteristic function, multivariate distributions, change of variables and functions of variables, central limit theorem, description of stochastic vectors. General concepts of stochastic processes, stationarity and ergodicity, stochastic continuity and differentiation, the Gaussian process, linear systems with stochastic inputs, correlation functions and power spectra,

matched filtering, stochastic orthogonality and linear mean-square estimation filtering and prediction. *Prep.* ECE 3108 or equivalent.**ECE 3242 Applied Probability and Stochastic Processes A** **2QH**
(formerly 03.900) **Fall and Winter Quarters**

ECE 3242 and ECE 3243 cover the same material with the same prerequisites as ECE 3241, but in two 2QH courses.

ECE 3243 Applied Probability and Stochastic Processes B **2QH**
(formerly 03.901) **Winter and Spring Quarters**Continuation of ECE 3242. *Prep.* ECE 3242.**ECE 3302 Power Circuit Analysis II** **2QH**
(formerly 03.926) **Winter Quarter**This course is a continuation of ECE 3120 Power Circuit Analysis I. Sequence impedances of various power-system elements are considered from an application point of view; unsymmetrical faults on otherwise symmetrical 3-phase systems; open conductors and asymmetrical connections and loadings; analysis of simultaneous faults on 3-phase systems. *Prep.* ECE 3120.**ECE 3303 Power Circuit Analysis III** **2QH**
(formerly 03.927) **Spring Quarter**This course is a continuation of ECE 3302, Power Circuit Analysis II. Introduction of Clarke components and applications in analysis of asymmetrical systems and faults; application of Clarke components to the solution of surge phenomena problems; transmission line theory; fundamentals of systems stability. *Prep.* ECE 3302.**ECE 3304 Solid State AC and DC Motor Control Systems** **2QH**
(formerly 03.929) **Winter Quarter**The application of solid-state devices to the control of AC and DC electrical machinery, including rectifiers, inverters, choppers and cycloconverters, as applied to drive systems in industry and transportation. The course will emphasize a case method approach. *Prep.* BSEE or ECE 3100 and ECE 3101.**ECE 3305 Computers in Power Systems I** **2QH**
(formerly 03.935) **Fall Quarter**Techniques used in solving power system problems with the digital computer. Matrix formulations are examined, followed by a detailed treatment of the short-circuit problem, including balanced and unbalanced faults. Various iterative techniques are studied for the solution of the power-flow problem. *Prep.* BSEE or ECE 3120.**ECE 3306 Computers in Power Systems II** **2QH**
(formerly 03.936) **Winter Quarter**

Practical considerations of solving large scale networks are discussed. Network reductions, distribution factors and contingency analysis techniques are developed. Digital models for regulated generators, fixed and load tap changing transfor-

mers and HVDC transmission lines are examined. Computer methods for economic dispatch, loss coefficients and application of pumped hydro are developed. *Prep. ECE 3305.*

ECE 3308 Electrical Machinery Theory II 2QH
(formerly 03.941) Winter Quarter

Mathematical description of a synchronous machine; per-unit representation; steady-state theory and transient performance; flux distribution and saturation in synchronous machines. *Prep. ECE 3130.*

ECE 3309 Electrical Machinery Theory III 2QH
(formerly 03.942) Spring Quarter

Review of transient behavior of synchronous machines; stability studies and excitation systems; synchronous machine modeling; generator protection; trends in development of large generators. *Prep. ECE 3308.*

ECE 3311 Software Engineering I 4QH
(formerly 03.896) Fall Quarter

An introduction to basic concepts in software engineering principles is given. Techniques of structured software design and testing are discussed along with issues of program reliability and complexity. Management techniques are touched upon and a case study of a typical large software problem is undertaken. *Prep. ECE 3105, 3106, 3107 or equivalent, and a knowledge of a high-level programming language.*

ECE 3312 Software Engineering I-A 2QH
(formerly 03.893) Fall and Winter Quarters

ECE 3312 and ECE 3313 cover the same material with the same prerequisites as ECE 3311, but in two 2QH courses.

ECE 3313 Software Engineering I-B 2QH
(formerly 03.894) Winter and Spring Quarters

Continuation of ECE 3312. *Prep. ECE 3312.*

ECE 3314 Software Engineering II 2QH
(formerly 03.895) Spring Quarter

Focus turns away from the general issues of the first two courses in this sequence and toward a very specific issue, modular design of software. Issues of stepwise refinement and top-down design are explored in depth, and organizational/data-flow issues are considered. *Prep. ECE 3311.*

ECE 3321 Digital Signal Processing 4QH
(formerly 03.8T9) Winter Quarter

Theory and practice of modern signal processing techniques. Characteristics of discrete signals and systems; sampling and A/D conversion; difference equations; convolution; the z-transform, the Fourier transform and the discrete Fourier transform; fast Fourier transform algorithms; chirp z-transform algorithm; digital filter realizations; design techniques for IIR and FIR digital filters; computer programs for filter design; quantization effects in digital signal processing. *Prep. ECE 3321.*

ECE 3322 Digital Signal Processing A 2QH
(formerly 03.8T7) Fall and Winter Quarters

ECE 3322 and ECE 3323 cover the same material with the same prerequisites as ECE 3321, but in two 2QH courses.

ECE 3323 Digital Signal Processing B 2QH
(formerly 03.8T8) Winter and Spring Quarters

Continuation of ECE 3322. *Prep. ECE 3322.*

ECE 3325 Numerical Methods and Computer Applications I 4QH
(formerly 03.8T0) Winter Quarter

Survey of numerical methods applied to engineering and scientific problems with emphasis on machine implementation and problem solving; roundoff errors and cumulative errors; difference and summation calculus; roots of polynomials and nonlinear functions; orthogonal functions including polynomial, least squares, and Chebyshev approximation of functions; systems of algebraic equations, matrix notation, and machine implementation; inversion of matrices including iterative methods; sparse matrix techniques. Interpolation; numeric quadrature; numeric integration of ordinary differential equations including predictor-corrector methods; stiff dynamic equations, partial differential equations, approximations, boundary value problems. *Prep. Admission to Graduate School and a working knowledge of FORTRAN.*

ECE 3326 Numerical Methods and Computer Applications I-A 2QH
(formerly 03.8T1) Fall and Winter Quarters

ECE 3326 and ECE 3327 cover the same material with the same prerequisites as ECE 3325, but in two 2QH courses.

ECE 3327 Numerical Methods and Computer Applications I-B 2QH
(formerly 03.8T2) Winter and Spring Quarters

Continuation of ECE 3326. *Prep. ECE 3326.*

ECE 3328 Numerical Methods and Computer Applications II 4QH
(formerly 03.8T3) Spring Quarter

Spectral analysis, including fast Fourier transforms, Hilbert transforms, convolution, and correlation techniques. Optimization, including dynamic programming and steepest descent techniques. PERT and linear programming. Other selected topics. *Prep. ECE 3325 or ECE 3327.*

ECE 3331 Linear Active Circuits 4QH
(formerly 03.842) Winter Quarter

Active compound circuits with emphasis on IC circuit topologies are developed as an extension of known discrete active device characteristics. Use is made of modern circuit theory techniques, including flowgraphs, matrices, Blackman's formulation for feedback and frequency response in terms of natural frequencies to determine compound circuit limitations. Models of IC operational amplifiers, instrumentation amplifiers, voltage

comparators, and the like are developed and analyzed. Advantages and limitations of these IC active circuits are investigated. IC operational amplifiers, advantages and limitations including dynamic range, overload characteristics, and slow rate. Gain-bandwidth and speed characteristics are investigated for large and small signal conditions. Feedback, stability, and compensation in closed-loop systems and effects of feedback on impedance levels are explored. Applications for analog signal processing and conditioning, i.e., active filter design, summing, integration and coefficient amplifiers are investigated. Limitations caused by shot and thermal noise, definition of noise figure, and noise models are taken up. *Prep. ECE 3101 or equivalent.*

ECE 3332 Linear Active Circuits A **2QH**
(formerly 03.840) **Fall Quarter**

ECE 3332 and ECE 3333 cover the same material with the same prerequisites as ECE 3331, but in two 2QH courses.

ECE 3333 Linear Active Circuits B **2QH**
(formerly 03.841) **Winter Quarter**
Continuation of ECE 3332. *Prep. ECE 3332*

ECE 3341 Electromagnetic Theory **4QH**
(formerly 03.877) **Fall Quarter**

Maxwell's equations and related electromagnetic laws and relations; basic properties of matter; electromagnetic potentials; the scalar and vector Poisson, D'Alembert, and Helmholtz equations; Green's functions; both mathematical and physical aspects of the theory and their relation to engineering applications. Basic radiation phenomenon including retarded potentials, radiation from moving charges, electromagnetic energy, and energy-related theorems. *Prep. ECE 3102 or equivalent.*

ECE 3342 Electromagnetic Theory A **2QH**
(formerly 03.875) **Fall Quarter**

ECE 3342 and ECE 3343 cover the same material with the same prerequisites as ECE 3341, but in two 2QH courses.

ECE 3343 Electromagnetic Theory B **2QH**
(formerly 03.876) **Winter Quarter**
Continuation of ECE 3342. *Prep. ECE 3342*

ECE 3344 Advanced Electromagnetic Theory **4QH**
(formerly 03.87G) **Winter Quarter**

More advanced topics in electromagnetic theory including: waveguides, antennas, diffraction, and scattering; approximation techniques for obtaining useful solutions of field theory problems including integral equation, perturbation, and variational techniques. Special relativity and relativistic electrodynamics. Radiation from moving charges. Statistical concepts and propagation in random media *Prep. ECE 3341*

ECE 3345 Advanced Electromagnetic Theory A **2QH**
(formerly 03.878) **Winter Quarter**

ECE 3345 and ECE 3346 cover the same material with the same prerequisites as ECE 3344, but in two 2QH courses.

ECE 3346 Advanced Electromagnetic Theory B **2QH**
(formerly 03.879) **Spring Quarter**

Continuation of ECE 3345. *Prep. ECE 3345.*

ECE 3347 Computational Methods in Electromagnetics **4QH**
(formerly 03.8H7) **Spring Quarter**

Modern numerical methods are presented for solving problems in transmission, radiation, and scattering of electromagnetic waves. Individual topics will be discussed from both the viewpoint of understanding the relevant theory and the associated numerical technique. Integral equations will be introduced along with solutions by the method of moments. Applications will be given related to wire structures. Classical scattering from two-dimensional structures will be considered from the viewpoint of basic functions and edge effects. Scattering from more general shapes will proceed from the geometrical theory of diffraction. As time permits, computational methods in inverse scattering, target recognition, and transient radiation problems will be considered. *Prep. ECE 3341.*

ECE 3348 Computational Methods in Electromagnetics A **2QH**
(formerly 03.8H5) **Fall Quarter**

ECE 3348 and ECE 3349 cover the same material with the same prerequisites as ECE 3347, but in two 2QH courses.

ECE 3349 Computational Methods in Electromagnetics B **2QH**
(formerly 03.8H6) **Winter Quarter**

Continuation of ECE 3348. *Prep. ECE 3348.*

ECE 3351 Digital Communications **4QH**
(formerly 03.9C3) **Winter Quarter**

Deals with the theoretical and practical aspects of digital communications in the presence of channel distortion and additive noise. Topics covered include the basic binary and M-ary modulation techniques, namely, PSK, PAM, FSK, orthogonal and biorthogonal signals, and their performance in an additive Gaussian noise channel; signal waveforms constructed from binary block and convolutional codes; hard-decision decoding and soft-decision decoding of coded signal waveforms; performance of coded waveforms in an additive white Gaussian noise channel. Signal design techniques for band-limited channels; Nyquist criteria; effect of channel amplitude and delay distortion on digital signals; discussion of several adaptive equalization algorithms for combating intersymbol interference. maximum likeli-

hood sequence estimation and the Viterbi algorithm; the characterization of fading multipath channels; diversity reception techniques; coding for fading channels. *Prep. ECE 3241 and ECE 3104 or equivalent.*

ECE 3352 Digital Communications A 2QH
(formerly 03.9C1) Fall Quarter

ECE 3352 and ECE 3353 cover the same material with the same prerequisites as ECE 3351, but in two 2QH courses.

ECE 3353 Digital Communications B 2QH
(formerly 03.9C2) Winter Quarter

Continuation of ECE 3352. *Prep. ECE 3352.*

ECE 3361 Detection and Estimation Theory 4QH
(formerly 03.909) Winter Quarter

This course presents the classical theory of detection and estimation of signals in noise with emphasis on computer implementation of the theory. Particular topics include: hypothesis testing criteria; coherent detection of M-ary signals; diversity receiver; calculation of error probabilities. Detection in colored noise; parameter estimation using Bayes, maximum-likelihood, a maximum land posteriori criteria; applications in pattern recognition and radar. *Prep. ECE 3241.*

ECE 3362 Detection and Estimation Theory A 2QH
(formerly 03.906) Winter Quarter

ECE 3362 and ECE 3363 cover the same material with the same prerequisites as ECE 3361, but in two 2QH courses.

ECE 3363 Detection and Estimation Theory B 2QH
(formerly 03.907) Spring Quarter

Continuation of ECE 3362. *Prep. ECE 3362.*

ECE 3371 Linear Optimal Control Theory 4QH
(formerly 03.9A8) Spring Quarter

Introduction to linear optimal control systems. The optimal linear regulator and matrix ricatti equation, tracking problems, steady state and transient analysis, sensitivity, effects of uncertainty. Optimal linear state reconstruction, optimal linear output feedback, computer implementation of linear optimal control. *Prep. ECE 3221.*

ECE 3372 Linear Optimal Control Theory A 2QH
(formerly 03.9A6) Winter Quarter

ECE 3372 and ECE 3373 cover the same material with the same prerequisites as ECE 3371, but in two 2QH courses.

ECE 3373 Linear Optimal Control Theory B 2QH
(formerly 03.9A7) Spring Quarter

Continuation of ECE 3372. *Prep. ECE 3372.*

ECE 3381 Classical Control Theory 4QH
(formerly 03.959) Fall Quarter

Classical analysis techniques for continuous and sampled-data control systems. Discussion of stability criteria; application of root-locus and Bode methods for complementary time and frequency-domain analysis. Computer simulation of typical control systems will be emphasized. A review of cascade and feedback compensation techniques with the use of classical criteria for design of continuous and sampled-data control systems. Consideration of the multiple-input problem. A survey of pole-zero synthesis methods, and comparison with other techniques. Computer simulation of design examples. *Prep. ECE 3221.*

ECE 3382 Classical Control Theory A 2QH
(formerly 03.957) Fall Quarter

ECE 3382 and ECE 3383 cover the same material with the same prerequisites as ECE 3381, but in two 2QH courses.

ECE 3383 Classical Control Theory B 2QH
(formerly 03.958) Winter Quarter

Continuation of ECE 3382. *Prep. ECE 3382.*

ECE 3384 Characteristics and Models of Solid State Devices I 4QH
(formerly 03.8G0) Winter Quarter

This course is designed to develop insight into the operation of a broad range of semiconductor devices. Important topics in the physics of semiconductors to provide the background necessary for device analysis are discussed. Analysis of fundamental building-block units of which devices are made including PN junction, the Ohmic contact and the Schottky barrier. Each is examined under reasonable extremes of bias and temperature to establish the electrical behavior expected from such elementary units. Detailed analysis of bipolar transistor, metal-oxide-semiconductor interface, its influence on the behavior of real junctions, and the various realizations of the field-effect transistor. *Prep. BSEE or ECE 3101 and ECE 3102.*

ECE 3385 Characteristics and Models of Solid State Devices I-A 2QH
(formerly 03.8G1) Fall Quarter

ECE 3385 and ECE 3386 cover the same material with the same prerequisites as ECE 3384, but in two 2QH courses.

ECE 3386 Characteristics and Models of Solid State Devices I-B 2QH
(formerly 03.8G2) Winter Quarter

Continuation of ECE 3385. *Prep. ECE 3385.*

ECE 3387 Characteristics and Models of Solid State Devices II 2QH
(formerly 03.8G3) Spring Quarter

A detailed analysis of the performance of FETs will permit a critical comparison of field effect and

bipolar transistors. Solid state microwave devices; devices that are both unique to microwave applications and the relevant low-frequency elements which require somewhat different analysis at microwave frequencies. An examination of noise in semiconductor devices. *Prep. ECE 3384.*

ECE 3391 Digital Computer Architecture 4QH
(formerly 03.979) **Fall Quarter**

This course is directed toward the design of a complete computer in register transfer language. Analysis and synthesis of combinational and sequential circuits. Organization and detailed logic design of an elementary digital computer. Other topics may include buss organization, interfacing with asynchronous peripherals, digital logic families, hardware/software tradeoffs, address modes, and memory hierarchies. *Prep. ECE 3103 or equivalent.*

ECE 3392 Digital Computer Architecture A 2QH
(formerly 03.972) **Fall and Winter Quarters**

ECE 3392 and ECE 3393 cover the same material with the same prerequisites as ECE 3391, but in two 2QH courses.

ECE 3393 Digital Computer Architecture B 2QH
(formerly 03.973) **Winter and Spring Quarters**
Continuation of ECE 3392. *Prep. ECE 3392*

ECE 3394 Microprogramming 2QH
(formerly 03.974) **Spring Quarter**
Topics in microprogramming and emulation including microprogramming concepts and techniques; microprogramming design approach using register transfer notation and precedence graphs; microprogrammed computers, bit-slice microprogramming, microprogramming a specific machine for emulation using a microprogramming language and its simulator; current trends in microprogramming languages and support tools. *Prep. ECE 3391*

ECE 3395 Elements of VLSI Design 4QH
(formerly 03.8E6) **Spring Quarter**
MOS devices and circuits, fabrication of integrated systems, design rules, subsystems design examples, implementation of integrated systems designs. *Prep. ECE 3331.*

ECE 3396 Elements of VLSI Design A 2QH
(formerly 03.8E4) **Fall Quarter**
ECE 3396 and ECE 3397 cover the same material with the same prerequisites as ECE 3395, but in two 2QH courses.

ECE 3397 Elements of VLSI Design B 2QH
(formerly 03.8E5) **Winter Quarter**
Continuation of ECE 3396. *Prep. ECE 3396.*

ECE 3412 Power System Planning 4QH
(formerly 03.931) **Spring Quarter**
Engineering and economic considerations underlying the planning and development of modern

interconnected power systems. Consideration of overall planning strategies involved in economic comparison of alternative development schemes. *Prep. ECE 3120.*

ECE 3415 Power Systems Protection 2QH
(formerly 03.932) **Winter Quarter**
Consideration of protection applied to generation, transmission, and distribution. Investigation of the characteristics and operating principles of various methods of protective relaying; analysis of current techniques pertaining to system protection. *Prep. ECE 3303.*

ECE 3416 Power System Transients 2QH
(formerly 03.933) **Fall Quarter**
Transients in power systems due to system switching, lightning, or faults. Traveling-wave phenomena; insulation coordination; overvoltages due to disturbances on the system; surge protection. *Prep. ECE 3303.*

ECE 3423 Special Topics in Power 2QH
(formerly 03.944) **Spring Quarter**
Directed reading and discussion of topics of special interest in the power field. Series of lectures by guest speakers from industry on topics of particular interest to the power student. *Prep. Permission of Instructor.*

ECE 3424 Power System Dynamics 2QH
(formerly 03.945) **Spring Quarter**
Transient system models; small and large scale oscillations; solution of swing equation for single and multigenerator cases; load frequency and voltage controllers and transient stability. *Prep. ECE 3303.*

ECE 3430 Studies in Electric Power Transmission II 2QH
(formerly 03.955) **Fall Quarter**
Elements in the design of AC overhead transmission lines; thermal limitation, series and shunt compensation, environmental effects; consideration of transposition, induced effects, and insulation level. Underground alternatives to overhead lines. Elements of distribution. *Prep. ECE 3303.*

ECE 3431 Studies in Electric Power Transmission II 2QH
(formerly 03.956) **Winter Quarter**
Fundamental concepts of high voltage DC power transmission; rectifier and inverter performance; regulation; protection; reactive power and filter requirements; practical arrangement of DC lines; the impact of a DC line on overall power system operation. *Prep. ECE 3303.*

ECE 3440 Microprocessor-Based Design 4QH
(formerly 03.8F3) **Spring Quarter**
The role of the microcomputer in integrated/firmware/software/systems is explored. Techniques such as interfacing and regulation by microcomputer are examined, relative to both architectural and firmware requirements. Special purpose modular hardware is examined, and tech-

niques of top-down modular software design are introduced. *Prep. ECE 3391.*

ECE 3441 Microprocessor-Based Design A 2QH
(formerly 03.8F1) Fall Quarter

ECE 3441 and ECE 3442 cover the same material with the same prerequisites as ECE 3440, but in two 2QH courses.

ECE 3442 Microprocessor-Based Design B 2QH
(formerly 03.8F2) Winter Quarter
Continuation of ECE 3441. *Prep. ECE 3441.*

ECE 3443 Theory of Computation 4QH
(formerly 03.8F0) Spring Quarter
This course deals with basic abstract models of computation. Topics include Turing machines, primitive recursive functions, recursive systems of equations and abstract families of algorithms. Unsolvable problems are examined, along with the Recursion Theorem. *Prep. ECE 3200.*

ECE 3444 Theory of Computation A 2QH
(formerly 03.985) Fall Quarter
ECE 3444 and ECE 3445 cover the same material with the same prerequisites as ECE 3443, but in two 2QH courses.

ECE 3445 Theory of Computation B 2QH
(formerly 03.986) Winter Quarter
Continuation of ECE 3444. *Prep. ECE 3444.*

ECE 3447 Switching Theory I 4QH
(formerly 03.966) Spring Quarter
Logical design of combinational switching circuits, including minimization and decomposition of switching functions; multiple output networks; symmetric networks; threshold logic, fault detection. Logic design of sequential switching circuits including finite-state machine model; iterative networks; capabilities and limitations of finite-state machines; state equivalence; synthesis of asynchronous sequential circuits; state assignment problem and partition theory; machine decomposition. Logical design of sequential switching circuits, including the finite-state machine model; iterative networks; capabilities and limitations of finite-state machines; state equivalence; synthesis of asynchronous sequential circuits; state assignment problem and partition theory; machine decomposition. *Prep. ECE 3200.*

ECE 3448 Switching Theory I-A 2QH
(formerly 03.967) Fall Quarter
ECE 3448 and ECE 3449 cover the same material with the same prerequisites as ECE 3447, but in two 2QH courses.

ECE 3449 Switching Theory I-B 2QH
(formerly 03.968) Winter Quarter
Continuation of ECE 3448. *Prep. ECE 3448.*

ECE 3450 Switching Theory II 2QH
(formerly 03.969) Spring Quarter
Selected topics from the theory of finite automata, including such topics as machine experiments; information lossless machines; linear sequential machines; finite-state recognizers. *Prep. ECE 3447.*

ECE 3451 Combinatorial Methods and Optimization Techniques 4QH
(formerly 03.888) Winter Quarter
An introductory course in applied combinatorial mathematics which treats selected topics in enumerative analysis. Particular subjects include permutations, combinations, generating functions, recurrence relations, and the principle of inclusion and exclusion. Polya's theory of counting; selected topics in optimization techniques, which include transport networks, matching theory, linear programming, and an introduction to dynamic programming. *Prep. ECE 3200.*

ECE 3452 Combinatorial Methods and Optimization Techniques A 2QH
(formerly 03.898) Winter Quarter
ECE 3452 and ECE 3453 cover the same material with the same prerequisites as ECE 3451, but in two 2QH courses.

ECE 3453 Combinatorial Methods and Optimization Techniques B 2QH
(formerly 03.899) Spring Quarter
Continuation of ECE 3452. *Prep. ECE 3452.*

ECE 3454 Graph Theory 2QH
(formerly 03.837) Spring Quarter
Fundamentals of graph theory, including blocks, trees, connectivity, partitions, traversability, line graphs, factorization, coverings, planarity, matrices, digraphs, and enumeration problems. Selected applications of graph theory in such fields as network theory, switching theory, and computer science. *Prep. ECE 3211.*

ECE 3460 Special Topics in Computer Engineering 2QH
(formerly 03.988) Spring Quarter
Aspects of computer engineering not covered in other courses. The subject matter may change from year to year.

ECE 3463 Robotic Sensors 4QH
Winter Quarter

The main theme of this course is acquisition and processing of information for robot control. The subject is divided into two parts along the functional use of sensory information. Internal sensors, which monitor the state of the robot system (joint load, balance, kinesthesia, temperature, etc.) are analyzed first. The external sensors, which allow the system to interact with the environment are the second major topic of the course. These include proximity, rangefinding and

vision. Topics for study will be chosen from the following areas: low level vision, 3-D vision, real time image understanding, theory of shape, theory of motion, etc. The objective of the course is to analyze the pertinence of different sensory modalities to endow the next generation of robots with "intelligent" behavior. Students will be required to participate in the weekly research reviews. Each student will have to complete a design project by simulating relevant problems in LISP environment. *Prep. Permission of Instructor.*

ECE 3464 Robotic Sensors A **2QH**
Fall Quarter

ECE 3464 and ECE 3465 cover the same material with the same prerequisites as ECE 3463, but in two 2QH courses.

ECE 3465 Robotic Sensors B **2QH**
Winter Quarter

Continuation of ECE 3464. *Prep. ECE 3464.*

ECE 3466 Intelligent Robots **4QH**
(formerly 03.874) Spring Quarter

The course focuses on studies of intelligent interactions between robots and their environments. An important issue is the implementation of a goal directed behavior with emphasis on sensory driven locomotion and manipulation. "Robot as an Intelligent Agent" is the general topic under which these concepts are introduced during the first three weeks of the course. The second major topic deals with attempts to constrain the problem of machine perception from an engineering point of view. Finally, the high level concepts such as learning, knowledge representation, adaptation and self-organization are discussed in the context of artificial intelligence. *Prep. ECE 3463.*

ECE 3467 Intelligent Robots A **2QH**
Winter Quarter

ECE 3467 and ECE 3468 cover the same material with the same prerequisites as ECE 3466, but in two 2QH courses.

ECE 3468 Intelligent Robots B **2QH**
Spring Quarter

Continuation of ECE 3467. *Prep. ECE 3467.*

ECE 3469 Fault-Tolerant Computers **4QH**
Winter Quarter

Concepts of computer systems structures and specifications; software and hardware interactions; failure and reliability; errors and faults. Study of different types of faults; fault prevention and fault tolerance; redundancy management; reliability and availability. Comparisons of existing fault-tolerant computer architectures such as SIFT, FTMP, Tandem 16, and Stratus/32. Techniques of error detection and error recovery. Mechanisms for damage confinement and damage assessment. Study of software fault tolerance techniques such as recovery block scheme, deadline mechanism, and N-version programming scheme. *Prep. ECE 3391.*

ECE 3470 Fault-Tolerant Computers A **2QH**
Winter Quarter

ECE 3470 and ECE 3471 cover the same material with the same prerequisites as ECE 3469, but in two 2QH courses.

ECE 3471 Fault-Tolerant Computers B **2QH**
Spring Quarter

Continuation of ECE 3470. *Prep. ECE 3470.*

ECE 3501 Spectral Estimation Techniques **2QH**
(formerly 03.8U1) Spring Quarter

Estimation of power spectra; the periodogram; modified periodogram; parametric methods for estimation of the power spectrum; autoregressive models; the Levinson algorithm; maximum entropy method and the Burg algorithm; moving average and autoregressive-moving average models; maximum likelihood methods; applications of methods in communications; speech processing and seismic signal processing. *Prep. ECE 3321*

ECE 3502 Special Topics in Digital Signal Processing-Fast Algorithms **2QH**
(formerly 03.8U4) Spring Quarter

Fast algorithms for implementation of digital filters and discrete Fourier transforms: FFT, convolution algorithm, Number Theoretic Transforms (NTT), filtering computation, and polynomial transforms. *Prep. ECE 3321.*

ECE 3503 Two-Dimensional Digital Signal Processing **2QH**
(formerly 03.8U7) Winter Quarter

This course is concerned with two-dimensional digital signal processing which is finding wide applications in many diversified areas. Covers 2-D shift invariant systems along with their stability, the 2-D Discrete Fourier Transform (DFT) and its FFT implementation, and 2-D digital filter design and implementation. *Prep. ECE 3321.*

ECE 3504 Digital Processing of Speech Signals **2QH**
(formerly 03.9B1) Fall Quarter

Models of speech production, waveform coding of speech, transform coding of speech and speaker recognition systems. *Prep. ECE 3321.*

ECE 3505 Digital Image Processing **4QH**
(formerly 03.9D3) Spring Quarter

An introduction to the generation and processing of digital images. The course emphasizes the random-vector nature of digital images and uses linear system theory, matrices, and probability theory to develop the various topics. These include the generation of a digital image from the source, through the optical system, to the detector; sampling and quantization of the optical signal; and the enhancement techniques such as histogram mapping, contrast boosting, and edge sharpening. Image restoration by Weiner filtering, maximum entropy estimation, singular value decomposition, and spatially varying filters, image

coding with Huffman codes, DPCM, Transform (Walsh, KL, discrete cosine) coding, runlength encoding, adaptive optics, feature analysis, and hardware for a typical digital image processing system. *Prep. ECE 3321.*

ECE 3506 Digital Image Processing A 2QH
(formerly 03.9D1) Fall Quarter

ECE 3506 and ECE 3507 cover the same material with the same prerequisites as ECE 3505, but in two 2QH courses.

ECE 3507 Digital Image Processing B 2QH
(formerly 03.9D2) Winter Quarter

Continuation of ECE 3506. *Prep. ECE 3506.*

ECE 3511 Data Communications Networks 4QH
(formerly 03.8F6) Spring Quarter

Elements of computer-communication networks; network topology and design; elements of protocols, routing and network control; queuing and congestion control; description and comparison of several existing computer networks. *Prep. ECE 3241.*

ECE 3512 Data Communications Network A 2QH
(formerly 03.8F4) Winter Quarter

ECE 3512 and ECE 3513 cover the same material with the same prerequisites as ECE 3511, but in two 2QH courses.

ECE 3513 Data Communications Network B 2QH
(formerly 03.8F5) Spring Quarter

Continuation of ECE 3512. *Prep. ECE 3512.*

ECE 3514 Error Correcting Codes 4QH
(formerly 03.9A0) Spring Quarter

Error correcting codes and their decoding techniques which show promise for applications in digital communication, control and computer systems. Emphasis is placed on the linear block codes based on algebraic structures; cyclic codes for random error correction (B-C-H codes) and burst error correction. Convolutional codes and decoding including the Viterbi algorithm, arithmetic codes. Combination of codes. Coding for ranging and synchronization. *Prep. ECE 3211.*

ECE 3515 Error Correcting Codes A 2QH
(formerly 03.9A1) Winter Quarter

ECE 3515 and ECE 3516 cover the same material with the same prerequisites as ECE 3514, but in two 2QH courses.

ECE 3516 Error Correcting Codes B 2QH
(formerly 03.9A2) Spring Quarter

Continuation of ECE 3515. *Prep. ECE 3515.*

ECE 3517 Information Theory 2QH
(formerly 03.903) Spring Quarter

Deals principally with three aspects of information theory; the statistical description of sources and probabilistic measure of their information con-

tents, the determination of channel capacity; and the fundamental coding theorems. *Prep. ECE 3211 and ECE 3351.*

ECE 3520 Special Topics in Communication Theory 2QH
(formerly 03.908) Spring Quarter

Current aspects of communication theory not covered in previous courses. Subject matter may change from year to year.

ECE 3523 Communication Systems 4QH
(formerly 03.870) Fall Quarter

Primarily concerned with radio communication systems as used in terrestrial and space communication applications. Antenna gain, space loss, cosmic and atmospheric noise, and receiver noise are considered as factors influencing the signal-to-noise ratio in space and satellite repeater systems. Contemporary systems are discussed from the standpoint of signal spectrum, noise power and message ambiguity as exhibited at the output of the intermediate frequency receiver. The theoretical aspects of amplitude and angle modulation systems are introduced and extended to cover multiplex systems; signal-to-noise ratio analysis of frequency multiplex systems; time division multiplex systems. Coverage of digital systems will include sampling, aliasing, and PCM/FM. Bit stream organization for transmission will be considered. A PCM encoder will be discussed as a means of matching the bit stream to the bandwidth. Illustrative examples will be drawn from contemporary communications systems used on balloons, rockets, and satellite repeaters. *Prep. ECE 3241 and ECE 3104 or equivalent.*

ECE 3524 Communication Systems A 2QH
(formerly 03.871) Fall Quarter

ECE 3524 and ECE 3525 cover the same material with the same prerequisites as ECE 3523, but in two 2QH courses.

ECE 3525 Communication Systems B 2QH
(formerly 03.872) Winter Quarter

Continuation of ECE 3524. *Prep. ECE 3524.*

ECE 3527 Nonlinear Systems I 2QH
(formerly 03.910) Fall Quarter, As Announced

Operators and functionals. Functional power series representation of nonlinear systems. Functional representation of the response of a nonlinear system when its input is either a constant, a sinusoid, or a transient. System transforms. Applications to the analysis and synthesis of nonlinear systems in terms of functional power series. *Prep. ECE 3241 and ECE 3221.*

ECE 3528 Nonlinear Systems II 2QH
(formerly 03.911) Winter Quarter, As Announced

Nonlinear systems with random inputs. Functional representation of the response of a nonlinear system when its input is a random process. Orthogonal systems of functionals. Representation and analysis of nonlinear systems in terms of orthog-

onal systems of functionals. The optimum nonlinear filter, predictor, and general operator. Special classes of nonlinear systems. Determination of optimum nonlinear systems for generalized error criteria. *Prep. ECE 3527.*

ECE 3529 Nonlinear Systems III 2QH
(formerly 03.912) **Spring Quarter, As Announced**

Functional analysis of systems characterized by nonlinear differential equations. Operator approach to system theory and its relationship to differential equation representations. The methods of iteration in nonlinear theory and its application to feedback systems. *Prep. ECE 3528.*

ECE 3530 Three-Dimensional Picture Processing 2QH
(formerly 03.887) **Spring Quarter**

The application of computer, optical, and analytic methods in abstracting geometrical information from pictures. Pictorial presentation of data trains into multidimensional pictures. Methods will be studied for reconstructing three-dimensional objects from two-dimensional pictures. Applications will be in the areas of X-ray analysis, radar target identification, microscopy, and sensory perception. Students will have the chance to pursue individual projects during the term. *Prep. ECE 3321.*

ECE 3540 Digital Control Systems 4QH
(formerly 03.8D6) **Spring Quarter**

Analysis of linear discrete-time dynamic systems; discretization of continuous systems; sampling and aliasing. Design of digital control systems using transform techniques by discrete equivalent and direct design methods; root locus, Bode and Nyquist diagrams and Nichols charts. Multivariant digital control using state-space methods; pole placement, observer, and regulator design. Controller implementation issues: digital filter realizations, nonlinear effects due to quantization, roundoff, deadband, limit cycles. Selection of the sampling rate. *Prep. ECE 3221.*

ECE 3541 Digital Control Systems A 2QH
(formerly 03.8D4) **Fall Quarter**

ECE 3541 and ECE 3542 cover the same material with the same prerequisites as ECE 3540, but in two 2QH courses.

ECE 3542 Digital Control Systems B 2QH
(formerly 03.8D5) **Winter Quarter**

Continuation of ECE 3541. *Prep. ECE 3541.*

ECE 3543 Stochastic Control Theory 4QH
(formerly 03.965) **Fall Quarter**

Statistical models for random signals; representation of dynamic systems excited by stochastic inputs. Optimal filtering, prediction and smoothing for discrete and continuous systems. Observer theory and feedback of estimated states for effective closed-loop control in a noisy environment. Estimation theory for dynamic systems based on

Bayesian and maximum likelihood methods. The system identification problem. Implementation of numerical algorithms for parameter identification and adaptive control. *Prep. ECE 3241 and ECE 3371.*

ECE 3544 Stochastic Control Theory A 2QH
(formerly 03.963) **Winter Quarter**

ECE 3544 and ECE 3545 cover the same material with the same prerequisites as ECE 3543, but in two 2QH courses.

ECE 3545 Stochastic Control Theory B 2QH
(formerly 03.964) **Spring Quarter**

Continuation of ECE 3544. *Prep. ECE 3544.*

ECE 3560 Acoustics I 2QH
(formerly 03.817) **Fall Quarter**

The wave theory of sound. Radiation, reflection, and transmission phenomena. Distributed system analogies, and sound measurements. *Prep. ECE 3341.*

ECE 3561 Acoustics II 2QH
(formerly 03.818) **Winter Quarter**

Speech and hearing, microphones and loudspeakers, guided waves, room acoustics. Environmental acoustics. *Prep. ECE 3560.*

ECE 3562 Acoustics III 2QH
(formerly 03.819) **Winter Quarter**

Scattering and diffraction. Effects of viscosity and heat conduction. Finite amplitude and shock waves. Introduction to underwater sound. *Prep. ECE 3561.*

ECE 3564 Radar Systems I 2QH
(formerly 03.865) **Fall Quarter**

Emphasis on the systems aspects of radar engineering. Topics covered include basic theory of radar detection, measurement of range, angle, and Doppler shift; classes of radar systems; types of radar noise; components of a radar system; matched filters and correlation receivers as applied to radar systems; fundamental ideas of radar system analysis. *Prep. ECE 3241.*

ECE 3565 Radar Systems II 2QH
(formerly 03.866) **Winter Quarter**

In-depth study of search radar theory; maximum likelihood estimation approach to measurement of radar target parameters; resolution and ambiguity functions applied to radar; radar parameter uncertainty principles. *Prep. ECE 3564.*

ECE 3566 Radar Systems III 2QH
(formerly 03.867) **Spring Quarter**

Advanced topics in radar systems engineering. Topics to be covered include: design considerations for multistatic radar systems, synthetic aperture radars; tracking systems; radar waveform synthesis; multifunction array radar techniques and selected topics in radar sensing techniques and devices. *Prep. ECE 3565.*

ECE 3568 Microwave Engineering Principles I**2QH****(formerly 03.880)****Fall Quarter**

Review of electromagnetic theory concepts directly applicable to analysis of microwave devices and systems. Theory of transmission lines and waveguides. *Prep. ECE 3341.*

ECE 3569 Microwave Engineering Principles II**2QH****(formerly 03.881)****Winter Quarter**

Circuit theory for waveguide systems. Impedance matching and transformation. Passive microwave devices. Cavity resonators. *Prep. ECE 3568.*

ECE 3570 Microwave Engineering Principles III**2QH****(formerly 03.882)****Spring Quarter**

Advanced topics in microwave theory. Topics to be covered include: propagation in anisotropic media; nonreciprocal and ferrite devices; beam-wave interactions; coupled mode theory; traveling wave devices; periodically loaded lines; couplers; polarizers; phase shifters; attenuators; microwave filter synthesis; microwave systems considerations. *Prep. ECE 3569.*

ECE 3572 Fourier Optics I**2QH****(formerly 03.916)****Winter Quarter**

This two-quarter sequence covers: optical diffraction and imaging problems as linear systems; necessary tools of Fourier analysis and linear systems analysis which occur when solving the scalar wave equation; waves and their properties; reflection, refraction, polarization, and propagation of waves; foundations of scalar diffraction theory — including Fresnel and Fraunhofer diffraction, interferometry, division of amplitude, division of wavefront, interferometric instrumentation, Fourier transforming, image properties of lenses, coherent and incoherent imaging; and advanced topics in the application of communication theory to optical problems, transfer and spread functions, spatial filtering, and holography. *Prep. ECE 3581.*

ECE 3573 Fourier Optics II**2QH****(formerly 03.917)****Spring Quarter**

Continuation of ECE 3572. *Prep. ECE 3572.*

ECE 3574 Fourier Optics III**2QH****(formerly 03.983)****Fall Quarter**

This course covers current topics of interest in Fourier optics and optical instrumentation. Application of coherence phenomena to optical instrumentation such as microdensitometers, microscopes, viewers, cameras, spectrophotometric and interferometric instruments; applications of holography, optical data processing and computing, holographic memories, optical modulation, noise and its effects on data collection, synthetic aperture optics and medical application of laser optics. *Prep. ECE 3573.*

ECE 3576 Lasers I**2QH****(formerly 03.806)****Fall Quarter**

Review of basic optical principles and atomic physics; introduction to optical coherence; models for the interaction of electromagnetic radiation with matter; a general description of lasers is given. *Prep. ECE 3341.*

ECE 3577 Lasers II**2QH****(formerly 03.807)****Winter Quarter**

Laser threshold and rate equations; elementary resonator theory and fabrication; giant pulse operation; specific solid-state, liquid, and gas lasers; and laser systems. *Prep. ECE 3576.*

ECE 3578 Lasers III**2QH****(formerly 03.808)****Spring Quarter**

Applications of lasers and laser systems for a variety of engineering and basic science disciplines; specific laser optoelectronic devices. *Prep. ECE 3577.*

ECE 3580 Electro-Optics I**2QH****(formerly 03.914)****Spring Quarter**

Survey of the basic concepts necessary for understanding and evaluating the optics involved in electro-optical systems. The optical system as a linear system; matrix methods; diffraction and interference; imaging and aberrations. *Prep. Bachelor of Science Degree in Engineering or Physics.*

ECE 3581 Electro-Optics II**2QH****(formerly 03.915)****Fall Quarter**

Survey of the basic concepts necessary for understanding electro-optical devices. Wave propagation in isotropic and non-isotropic media; optics of crystals; polarization; optical resonators; guided waves; modulators and detectors; thin-film optics. *Prep. ECE 3580.*

ECE 3583 Optical Properties of Matter I**2QH****(formerly 03.921)****Fall Quarter**

Optics of crystals; classification and effects of crystal symmetry on optical properties; classical description of wave propagation in crystals; applications of the theory to modulation, pulse generation, nonlinear optics. *Prep. Bachelor of Science Degree in Engineering or Physics.*

ECE 3584 Optical Properties of Matter II**2QH****(formerly 03.922)****Winter Quarter**

Introduction to electro-optical and magneto-optical effects in material media; linear and nonlinear optical materials; elasto-optic and acousto-optical materials; polarization and propagation effects; modulation. *Prep. ECE 3583.*

ECE 3585 Optical Properties of Matter III**2QH****(formerly 03.923)****Spring Quarter**

Thin films and optical fibers; multilayer filters; dichroics; integrated optics. *Prep. ECE 3584.*

ECE 3587 Principles of Optical Detection I**2QH****(formerly 03.981)****Winter Quarter**

Laws governing radiation and radiometry; properties of real radiation sources; detailed descrip-

tion of detection devices (image forming and signal generating); noise; contrast and MTF; detection systems (imaging devices and ranging devices); electro-optical detector systems analysis. *Prep. Bachelor of Science Degree in Engineering or Physics.*

ECE 3588 Principles of Optical Detection II

2QH
(formerly 03.982) **Spring Quarter**
Review of detector parameters; statistics of detector noise; practical considerations in real detectors; detection, resolution and recognition of signals; heterodyne detection and parametric amplification; subnanosecond pulse detection calibration of electro-optical detectors; detectors as system components. *Prep. ECE 3587.*

ECE 3589 Optical Storage and Display **2QH**
(formerly 03.913) **Spring Quarter**
Survey of materials and methods for the storage and display of information. Topics included are: photographic film, holograms, storage tubes, magneto-optical films, photochromic materials, electro-optical crystals, evaporated thin films and liquid crystals. *Prep. Bachelor of Science in Engineering or Physics.*

ECE 3590 Optical Instrumentation Design **2QH**
(formerly 03.980) **Fall Quarter**
An introduction to the design of optical instrumentation. Principles and basic concepts of optical systems. In sequence the topics are: introduction, mechanical shock and vibration, kinematic designs; application of third-order aberrations, simple optical ray tracing, optical testing, tolerances, optical instrumentation, philosophy, functional design, design for quantity production, quality assurance, "special order" design, industrial design, examples and exercises. *Prep. Bachelor of Science in Engineering or Physics.*

ECE 3591 Spectroscopic Instrumentation **2QH**
(formerly 03.984) **Winter Quarter**
Survey of optical instrumentation employed in analysis and control situations; modern methods of spectrometry and interferometry; optimization of analytical systems; topics in electron spectroscopy, X-ray spectroscopy, microwave spectroscopy, and related fields. *Prep. ECE 3581.*

ECE 3592 Remote Sensing **2QH**
(formerly 03.886) **Spring Quarter, As Announced**
The application of electromagnetic radiating for sensing the environment, subsurface geophysical exploration, and identifying remote objects. Basic goals are concerned with understanding the relevant electromagnetics in relation to the particular sensing system. Both time and frequency-domain sensing systems will be covered. As time permits, the application of pattern recognition methods to electromagnetic sensing will be discussed. *Prep. ECE 3341 or ECE 3343.*

ECE 3593 Plasma Engineering **2QH**
(formerly 03.800) **Fall Quarter, As Announced**
Behavior, diagnostics, and generation of plasma and gas discharges; emphasis on the engineering and experimental point of view rather than on a rigorous theoretical treatment. Current literature on a variety of plasma engineering applications will be introduced throughout the course. First-quarter topics include: dynamics of charged particles in static electric and magnetic fields, E and M wave-plasma interactions, infinite and finite media, elastic and inelastic collisions. *Prep. ECE 3341.*

ECE 3594 Plasma Theory **4QH**
(formerly 03.803) **Winter Quarter, As Announced**
Plasma electrodynamics and linear response theory. Fluid and Vlasov descriptions of plasmas with and without magnetic fields. Dispersion and damping of collective modes. Beam-plasma linear instabilities and application to shock-wave structures. Plasma electrodynamics and nonlinear response theory. Fluctuation-Dissipation theorems. Sum rules. New approaches to strongly correlated plasmas: equation of state, liquid-solid phase transitions, dispersion and damping of collective modes. Role of strongly correlated plasmas in laser- and heavy-particle beam-inertial confinement schemes in thermonuclear fusion. *Prep. ECE 3341.*

ECE 3595 Plasma Theory A **2QH**
(formerly 03.801) **Winter Quarter, As Announced**
ECE 3595 and ECE 3596 cover the same material with the same prerequisites as ECE 3594; but in two 2QH courses.

ECE 3596 Plasma Theory B **2QH**
(formerly 03.802) **Spring Quarter, As Announced**
Continuation of ECE 3595. *Prep. ECE 3595.*

ECE 3597 Thermonuclear Fusion Energetics I **2QH**
(formerly 03.810) **Fall Quarter, As Announced**
Application of the concepts developed in ECE 3593 and ECE 3595 to the problem of thermonuclear plasmas. Emphasis will be on magnetic confinement schemes. Both open (mirror machines) and closed (toroidal confinement machines) systems will be discussed.

ECE 3598 Thermonuclear Fusion Energetics II **2QH**
(formerly 03.811) **Winter Quarter, As Announced**
Continuation of magnetic confinement schemes. Trapped particle instabilities and anomalous transport effects will be discussed. Introduction to inertial confinement (laser fusion).

ECE 3599 Thermonuclear Fusion Energetics III **2QH**
(formerly 03.812) **Spring Quarter, As Announced**
Introduction to microinstabilities associated with laser fusion devices. Introduction to computer

modeling of plasmas. Discussion of recent advances in thermonuclear plasma generation by relativistic electron beams. *Prep. ECE 3598.*

ECE 3610 Electronics of Analog Signal Processing **4QH**

(formerly 03.8E3) Spring Quarter, As Announced
Analog signal acquisition and processing utilizing state of the art devices and circuit techniques such as adaptive filters in sampled data systems, CZTs for spectral analysis, correlated double sampling for improved S/N ratios and solid-state imaging systems. Linear and nonlinear processing with MOS, bipolar and CTDs such as CCDs and SAWs. Attention given to analog vs. digital approaches for implementation of similar applications, i.e., bandwidth requirements, throughput, accuracy, cost, etc. *Prep. ECE 3331 and ECE 3384.*

ECE 3611 Electronics of Analog Signal Processing A **2QH**

(formerly 03.8E1) Fall Quarter, As Announced
ECE 3611 and ECE 3612 cover the same material with the same prerequisites as ECE 3610, but in two 2QH courses.

ECE 3612 Electronics of Analog Signal Processing B **2QH**

(formerly 03.8E2) Winter Quarter, As Announced
Continuation of ECE 3611. *Prep. ECE 3611.*

ECE 3613 UHF and Microwave Circuits and Systems **4QH**

(formerly 03.8H3) Spring Quarter, As Announced

Brief review of waveguides, cavities, and striplines and their common descriptors. Some practical components of the microwave circuit including couplers, circulators, isolators, bends and tees. Scattering parameter descriptors. Microwave and UHF sources and amplifiers including both vacuum and solid-state devices. Frequency multiplication. Mixers. Parametric oscillators and amplifiers. Hybrid and monolithic microwave integrated circuits. *Prep. ECE 3341 and ECE 3384.*

ECE 3614 UHF and Microwave Circuits and Systems A **2QH**

(formerly 03.8H1) Fall Quarter
ECE 3614 and ECE 3615 cover the same material with the same prerequisites as ECE 3613, but in two 2QH courses.

ECE 3615 UHF and Microwave Circuits and Systems B **2QH**

(formerly 03.8H3) Winter Quarter
Continuation of ECE 3614. *Prep. ECE 3614.*

ECE 3616 Modern Active Circuits Synthesis and Design **4QH**

(formerly 03.845) Fall Quarter
Feedback systems, including multiloop amplifier design; techniques will be applied to integrated circuit realizations of basic active networks. Basic methods of active network synthesis are intro-

duced through three commonly used approaches: feedback amplifier, negative impedance converter, and gyrator; structures of Sallen and Key, Kuh, Linvill, Yanagisawa, Rohrer, Kinariwals, Sessler, and Calahan; consideration of the practical realization of NICs, and gyrators, standard decomposition methods and sensitivity; work of Sandberg, Larky, Newcomb, Daniels, Horowitz, and Thomas. *Prep. ECE 3331.*

ECE 3617 Modern Active Circuits Synthesis and Design A **2QH**

(formerly 03.843) Fall Quarter
ECE 3617 and ECE 3618 cover the same material with the same prerequisites as ECE 3616, but in two 2QH courses.

ECE 3618 Modern Active Circuits Synthesis and Design B **2QH**

(formerly 03.845) Winter Quarter
Continuation of ECE 3617. *Prep. ECE 3617.*

ECE 3619 Network Synthesis **4QH**

(formerly 03.832) Fall Quarter
Matrix circuit analysis including m-port parameter systems. Positive-real functions. Energy functions. Driving-point synthesis techniques for LC, RC, and RL networks. Driving-point synthesis of RLC networks. Properties of two-port networks. Two-port synthesis, including the parallel ladder realization. Lattice synthesis. *Prep. BSEE or ECE 3100 and ECE 3101.*

ECE 3620 Network Synthesis A **2QH**

(formerly 03.831) Winter Quarter
ECE 3620 and ECE 3621 cover the same material with the same prerequisites as ECE 3619, but in two 2QH courses.

ECE 3621 Network Synthesis B **2QH**

(formerly 03.832) Spring Quarter
Continuation of ECE 3620. *Prep. ECE 3620.*

ECE 3622 Special Topics in Electronics — Analog MOS LSI Circuits **2QH**

(formerly 03.862) Spring Quarter
This course covers selected topics of practical importance in the design of analog MOS integrated circuits. Principal topics are: NMOS & CMOS technology and devices; MOS transistor analog switch; digital — analog converters; comparators; analog — digital converters; sampled analog filtering concepts; switched — capacitor filters. *Prep. ECE 3331 and ECE 3384.*

ECE 3797 Engineer Degree Continuation **0QH**

(formerly 03.9Z3) Any Quarter
Candidates to sign up for thesis continuation if their thesis is not completed after they have registered for 3 consecutive quarters or 10 QH of EE degree thesis. Continuous registration is required until the candidate graduates.

ECE 3798 Master's Thesis Continuation **0QH**

(formerly 03.9X1) Any Quarter

- ECE 3799 PhD Continuation** **0QH**
(formerly 03.9X4) **Any Quarter**
ECE 3860 Master's Thesis **8QH**
(formerly 03.995) **Any Quarter**
Analytical and/or experimental work conducted under the auspices of the department. *Prep. Bachelor of Science degree in Engineering or Science.*
- ECE 3870 Engineer Degree Thesis**
(formerly 03.9Z2) **Any Quarter**
Analytical and/or experimental work conducted under the auspices of the department. Minimum of 4 QH, maximum of 8 QH allowed per quarter. *Prep. Admission to Engineer Degree Program.*
- ECE 3880 Doctoral Thesis** **0QH**
(formerly 03.996) **Any Quarter**
Theoretical and/or experimental work conducted under the auspices of the department. *Prep. Passing of PhD Qualifying Exam.*
- ECE 3887 Master's Seminar I** **2QH**
(formerly 03.990) **Any Quarter**
A library survey of a selected topic in the general field of electrical engineering with an oral presentation based on this survey. Participation in the departmental seminar program of guest lectures. *Prep. Bachelor of Science degree in Engineering or Science.*

- ECE 3888 Master's Seminar II** **2QH**
(formerly 03.991) **Any Quarter**
The preparation of a research paper suitable for publication in a professional journal, plus an oral presentation of this report. *Prep. ECE 3887.*
- ECE 3889 Doctoral Seminar** **0QH**
(formerly 03.993) **Any Quarter**
This requirement will be satisfied by the student presenting a seminar to the Electrical Engineering Department on a subject related to his/her PhD thesis. The thesis supervisor will coordinate the seminar. *Prep. Passing of PhD Qualifying Exam.*
- ECE 3892 Doctoral Reading** **0QH**
(formerly 03.997) **Any Quarter**
Material approved by the candidate's adviser. (Only S or F grades will be assigned for this course.) *Prep. Passing of PhD Qualifying Exam.*
- ECE 3893 Special Problems in Electrical Engineering** **2 or 4QH**
(formerly 03.998) **Any Quarter**
Theoretical or experimental work under individual faculty supervision. *Prep. Consent of Department Chairman.*
- ECE 3894 Engineer's Degree Reading**
(formerly 03.9Z1)
To be taken upon completion of 30 QH of satisfactory course work. *No credits toward course requirements are given.* Minimum of 4 QH, maximum of 8 QH allowed per quarter.

Biomedical

- OINT 3250 Engineering and Medicine I** **2QH**
(formerly 93.901) **Fall Quarter**
The intersection of technology with medicine; historical development of bioengineering profession; its impact on society; study of activities embraced by the profession today; educational, training, and career opportunities in clinical, biomedical, and medical engineering for individuals at the BS, MS, and PhD levels; future goals of engineering in biology and medicine; and issues basic to the relationship between new medical technology and the efficiency and effectiveness of the health care system. *Prep. Bachelor of Science in Engineering or allied field.*
- OINT 3251 Biomedical Applications of Heat and Mass Transfer** **2QH**
(formerly 93.911) **Winter Quarter**
Bioheat equation; thermal transport in living systems, thermal properties; thermal techniques in

the measurement of blood flow; applications of heat transfer in medicine including hyperthermia for cancer therapy, hypothermia for tissue and organ preservation and cryosurgery, thermal sources for implantable artificial heart; and thermography in cancer detection. *Prep. Bachelor of Science in Engineering or allied field.*

- OINT 3252 Selected Topics in Bioengineering** **2QH**
(formerly 93.912) **Spring Quarter**
Study of biomedical engineering appropriate to topics selected from fields of biomaterials, nuclear medicine, radiation diagnosis and therapy, biological transport processes, artificial organs, rehabilitation engineering, and microprocessor based clinical instruments. Introduction to medical technology assessment. *Prep. OINT 3250 or permission of instructor.*

Industrial Engineering

Each course description includes information on the expected quarter in which classes are usually offered. The quarters listed are presented here for planning purposes; however, the Graduate School of Engineering cannot guarantee that all courses will be offered. Students must refer to the Graduate School of Engineering Quarterly Course Offering sheets to determine what courses are actually offered in any given quarter and at what day and time.

IIS 3100 Basic Engineering Economy 2QH
(formerly 05.808) **Fall and Winter Quarters**
Economic analysis in formulating business policies and selecting alternatives from possible engineering solutions to industrial problems, present worth, annual cost, and rate of return techniques using discrete compound interest calculations. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3101 Industrial Accounting for Engineers 2QH
(formerly 05.810) **Fall, Winter, and Spring Quarters**
Introduction of basic accounting principles and procedures; use of accounting data as a management tool; a practical covering of basic cost accounting procedures related to materials, labor, and manufacturing expense cost control; job order, process, and standard cost systems. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3102 Introduction to Human Factors Engineering 2QH
(formerly 05.851) **Fall and Winter Quarters**
A survey of the principal topics and areas of concentration in the field. Includes introductory concepts of sensory physiology and sensory performance; basic motor capabilities and limitations; concepts of the human as a processor of information; and methods of gathering human performance data. Normally the first course in the human factors areas for students without behavioral science background. *Prep. IIS 3508 or permission of instructor.*

IIS 3103 Basic Operations Research 4QH
(formerly 05.900) **Fall and Winter Quarters**
An introduction to the theory and use of deterministic and stochastic models to represent industrial operations. Models included are those of linear programming, dynamic programming, inventory control, waiting lines, and Monte Carlo simulation. Embodies the material in IIS 3104 and IIS 3105. *Prep. IIS 3508.*

IIS 3104 Basic Operations Research I 2QH
(formerly 05.901) **Fall and Winter Quarters**
Introduction to the theory and use of deterministic models to represent industrial operations; includes linear programming, dynamic programming, networks, and game theory. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3105 Basic Operations Research II 2QH
(formerly 05.902) **Winter and Spring Quarters**
Introduction to the theory and use of stochastic models to represent industrial operations; includes queuing, inventory, and Markovian models. *Prep. IIS 3104 and IIS 3507 or equivalent.*

IIS 3106 Elements of Structured Programming 2QH
(formerly 05.920) **Fall, Winter, and Spring Quarters**
An introductory course to the principles and techniques of top down structures programming. The host language is PASCAL and topics covered include assignment statements, logical expressions, control statements, data structures, recursion and pointers. *Prep. Admission to Graduate Program.*

IIS 3107 Probability 2QH
(formerly 05.966) **Fall and Winter Quarters**
Same material as IIS 3108 and IIS 3109 but offered as a 4QH course. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3108 Probability I 2QH
(formerly 05.960) **Fall Quarter**
Fundamental concepts of probability. Events, event space, sample space, sampling. Axiomatic development events and the algebra of events. Counting, permutations, combinations. Discrete and continuous random variables. Density functions, mass functions, cumulative probability distributions. Expectation of random variables. Common discrete and continuous probability distributions including binomial, poison, geometric, uniform, exponential and normal. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3109 Probability II 2QH
(formerly 05.961) **Winter Quarter**
Multivariate probability distributions, marginal and conditional distribution. Expected value of functions of random variables, variance, covariance, and independence of random variables. Common multivariate distributions including the multinomial and the multivariate normal. Methods of determining the probability distributions of functions of random variables are discussed. *Prep. IIS 3108.*

IIS 3111 Principles of COBOL 2QH
(formerly 05.939) **Fall Quarter**
Fundamentals of computer programming in COBOL. Topics include elementary computer

functioning, program organization, input/output operations, arithmetic and data-handling verbs, and program logic development through the use of flow charts. Storage and manipulation of large data files on magnetic tape are introduced. No prior computer experience is required. *Prep. Admission to Graduate School*

IIS 3112 Quantitative Methods for Information Systems **4QH**

Winter Quarter

An introduction to the theory and use of deterministic and stochastic models in the context of computer and information systems. Models included are linear programming, dynamic programming, Monte Carlo simulation, Gant and Pert charts, multicriteria decision analysis and waiting lines. Class examples will emphasize applications in a computer and information systems environment. *Prep. Admission to Graduate Program.*

IIS 3200 Organizational Perspectives and Project Management **4QH**

Fall Quarter

Same material as IIS 3201 and IIS 3202 offered as a 4 QH course. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3201 Analysis of the Industrial Enterprise I **2QH**

(formerly 05.801) Fall and Winter Quarters

Introduction to business organization, management and operation. Business responsibility to employees, its product, the customer and to the environment in which it operates. What faces the industrial enterprise in its effort to become profitable. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3202 Analysis of the Industrial Enterprise II **2QH**

(formerly 05.802) Winter and Spring Quarters

A survey of modern planning, forecasting and budgeting. The financial markets; investing, speculating. Economic growth and controls. The interaction of politics, government and government controls on the industrial enterprise. Concerns of the engineering manager with these topics. *Prep. IIS 3201.*

IIS 3203 Engineering Project Management **2QH**

(formerly 05.841) Winter and Spring Quarters

Principles and practices of managing engineering projects in the prevailing complex environment of rapid technological advance, stiff competition, adverse economic conditions, ever-changing governmental regulations and the constraints of corporate operating policies are considered with a view to acquiring an awareness of and developing deeper insights to achieving personal and company objectives while meeting contractual commitments in the decade ahead. Particular emphasis

is placed on management throughout the project life cycle as well as on such topics as: planning the effort, organizing and integrating resources, measuring results, understanding and meeting contractual requirements, negotiating contracts and changes therein, developing personnel, and fulfilling entrepreneurial goals. The focus of this course is primarily on projects in industries based on the development or utilization of high technologies. *Prep. IIS 3213 or IIS 3215.*

IIS 3204 Engineering/Organizational Psychology **4QH**

Fall Quarter

Same material as IIS 3205 and IIS 3206 offered as a 4 QH course. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3205 Industrial Organizations **2QH**

(formerly 05.803) Fall and Winter Quarter

An analysis of the purpose and functioning of organizations as the basic networks for achievement of goals through coordination of effort, communication, and responsibility. The approach will emphasize the role and function of engineering in organizations and will be based on modern behavioral science concepts. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3206 Industrial Psychology for Engineers **2QH**

(formerly 05.816) Fall and Spring Quarter

A general coverage of the application of psychology to industry with emphasis on industrial environments and organization, human relations, group dynamics, tests and measurements, personnel practices, training, and motivation. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3207 Financial Management **4QH**

Winter Quarter

Same material as IIS 3208 and IIS 3209 offered as a 4 QH course. *Prep. IIS 3201 and IIS 3100 or equivalent.*

IIS 3208 Financial Management I **2QH**

(formerly 05.830) Fall and Winter Quarters

Study of the issues and processes of short-term financing on industrial firms; financial analysis of cases, supplemented by readings to develop familiarity with sources and uses of working capital as well as the goals and problems involved in its management. *Prep. IIS 3201 and IIS 3101, and IIS 3100 or equivalent.*

IIS 3209 Financial Management II **2QH**

(formerly 05.831) Spring Quarter

Extension of IIS 3208 with emphasis on analysis necessary to such long-term financial decisions as issuance of stock or bonds; contracting of leases or loans, and financing of a new enterprise; mergers, capital budgeting, the cost of capital, and the valuation of a business. *Prep. IIS 3208.*

IIS 3210 Industrial Budgeting for Engineers**2QH****(formerly 05.805)****Winter Quarter**

Budgeting plans, programs, and reports for industry today; an introduction to the essentials of fixed and variable budgeting for production, inventory, sales, cash, capital, and cost-volume-profit analysis. *Prep. IIS 3101 or equivalent.*

IIS 3211 Personnel Administration for Engineers**2QH****(formerly 05.820)****Fall Quarter**

Personnel programs for attracting and retaining technical talent; evaluating effectiveness of major personnel policies including relations with organized labor; modern methods of salary and wage administration; planning profitable relationships among company, supervisors, and employees. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3212 Cost Accounting for Engineers**2QH****(formerly 05.811)****Winter Quarter**

Cost accounting procedures as established by accountants are studied and evaluated in terms of being considered by the engineer for cost determination of alternative engineering proposals. *Prep. IIS 3101 or equivalent.*

IIS 3213 Managing Professional Personnel**2QH****(formerly 05.812)****Spring Quarter**

The science and art of managing creative people employed in research, developmental, and engineering activities are considered with a view to understanding the problems encountered by such people and their managers in the course of their professional work. Attention is devoted to some behavioral theories and their applications in the practice of management. Emphasis is placed on each student's own experiences as professionals or managers in diverse industrial settings. Interactive considerations of problems encountered by the students on their jobs provide case studies for analysis by the class and bases for further insights to the practices of managing professionals in several fields of endeavor. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3214 Engineering Communications**2QH****(formerly 05.813)****Spring Quarter**

Exploration of practice in the effective preparation and presentation, both written and oral, of the results of engineering projects and programs as a basis for business decisions: including formal reports, progress summaries, memoranda, and technical papers. The effective use of various media and audiovisual aids based on both audience and material. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3215 Development of Engineering Managers**2QH****(formerly 05.814)****Spring Quarter**

Analysis of the problems faced by the engineer in the transition from individual contributor to en-

gineering manager; the challenge of engineering management; integrating professional and management objectives; developing guides for engineering managers to examine their own work and performance and to improve their effectiveness as well as develop managerial skills in their subordinates. *Prep. IIS 3201.*

IIS 3216 Advanced Engineering Economy**2QH****(formerly 05.809)****Spring Quarter**

Principal emphasis on the practical application of the techniques studied in basic engineering economy; problems of implementation through class discussion of cases and student projects; recent advances in the techniques of engineering economy, especially those relating to the consideration of uncertainties. *Prep. IIS 3100 or equivalent.*

IIS 3300 Production Forecasting**2QH****(formerly 05.806)****Spring Quarter**

Econometric methods of forecasting the demand for industrial products; emphasis on techniques applicable to individual companies and the total demand. The principal tool used is the mathematical model of the causal factors with special attention to determining the reliability of the model. *Prep. IIS 3508 or equivalent.*

IIS 3301 Inventory Control and Production Planning**2QH****(formerly 05.903)****Winter Quarter**

The design and operation of inventory systems from a scientific management point of view, including both required theory and practical aspects. Subjects include inventory control models, statistical forecasting, production scheduling techniques, distribution systems, management control and reports, discussion of actual systems, and a case study. *Prep. IIS 3508 or equivalent.*

IIS 3302 Advanced Work Design**2QH****(formerly 05.817)****Spring Quarter**

Basic philosophies of work design; implementation of work design concepts with case studies; study and analysis of models such as work sampling, sequence or flow of work models; repetitive and nonrepetitive work models, and work measurement models such as standard data; human factors in measuring operator performance; regression analysis approaches; emphasis on development of professional, analytical, and managerial skills and abilities at a systems level. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3303 Product Design and Value Analysis**2QH****(formerly 05.822)****Fall Quarter**

Study of design parameters and their effect on development, manufacturing and procurement; functional analysis of components and systems; complete projects and case studies are integrated in the course. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3304 Production Analysis**4QH****(formerly 05.823)****Fall Quarter**

Study of advanced problem-solving techniques in the areas of method and measurement, layout and facilities planning, material handling and manufacturing process. Case studies and a course project in a local concern illustrate the concepts presented. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3305 Case Studies in Industrial Engineering**2QH****(formerly 05.824)****Spring Quarter**

Formulation of problems and analysis of situations on topics such as work measurement, line balancing, plant layout, regression analysis, wage and salary administration, management information systems and network analysis. Class discussion and written analysis of a variety of cases are included. *Prep. IIS 3304.*

IIS 3306 Network Planning and Control**2QH****(formerly 05.912)****Fall, Winter, and Spring Quarters**

Applications of stochastic networks to project management, scheduling, inventory, reliability, quality control and other industrial applications; review of PERT and its inadequacies, to the development of stochastic flow-graphs and networks; solving for the mean task times and variances using moment-generating functions; setting up the model for computer simulation using GERT. *Prep. IIS 3507.*

IIS 3307 Introduction to Microprocessors**2QH****(formerly 05.971)****Fall, Winter, and Spring Quarters**

A first course in microprocessor computing, covers hex codes for assembly language. Basics of architecture model, programming model and addressing modes. Instruction set for a typical machine. Programming techniques and details for a 6502 processor. Hands-on laboratory experimentation with typical interfacing problems. Case studies in the area of developing applications. Laboratory experimentation in a staffed facility. *Prep. Compiler level language.*

IIS 3308 Microcomputer Applications**2QH****(formerly 05.972)****Winter Quarter**

System architecture of several microcomputers including: microprocessor, bus design, multichip operations and current trends in processors (8, 16, and 32 BIT). Interfacing problems and hardware to include: sensors, actuators, A/D, D/A converters, data transmission and parallel/serial I/O. Real time programming with case studies. Network and distributed processing. Also included are development techniques and current state-of-the-art trends. *Prep. IIS 3307 or permission.*

IIS 3309 Computer Methods in Manufacturing**2QH****(formerly 05.974)****Winter and Spring Quarters**

In-depth coverage of the use of computers in selected areas of manufacturing systems design is presented. Possible topic areas are numerical control, MRP, process planning and control, and other important applications of computers to manufacturing systems. *Prep. IIS 3311 or permission.*

IIS 3310 Manufacturing Methods and Processes**2QH****(formerly 05.975)****Spring Quarter**

Material covered includes the structures of polymers (thermoplastic, thermosetting and glasses). Manufacturing processes for polymers including thermoforming are included. Structure of metals, the manufacturing processes for metal forming are presented. Alloys and welding and brazing are also included. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3311 Computer-Aided Manufacturing**2QH****(formerly 05.980)****Fall, Winter, and Spring Quarters**

A first course (overview) of computer aided manufacturing. Coverage of the areas that encompass the term CAM are group technology, material requirements planning, part coding and classification, numerical control, part programming and management systems. Broad coverage of each of the areas is given to allow the student to gain an appreciation of the coming review of the automated factory. *Prep. Compiler level language.*

IIS 3400 Human Factors Engineers**4QH****As Announced**

Same material as IIS 3401 and IIS 3402 offered as a 4 QH course. *Prep. IIS 3102.*

IIS 3401 Human Factors - Sensory Motor**2QH****(formerly 05.819)****Winter and Spring Quarters**

Design of equipment and systems for human use; emphasis on the application of engineering psychology; visual and auditory presentation of information — human information processing and skilled task performance — compatibility and equipment design. *Prep. IIS 3102 or equivalent.*

IIS 3402 Human Factors — Work Environment**2QH****(formerly 05.852)****Fall Quarter**

Focuses upon the human as a work-performing, heat-generating physiological engine. Examines the implied restrictions upon the equipment and workplace to provide occupational safety and effective man/machine performance. *Prep. IIS 3102 or equivalent.*

IIS 3403 Occupational Health and Safety**4QH****Winter Quarter**

Same material as IIS 3404 and IIS 3405 offered as a 4 QH course. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3404 Introduction to Occupational Health and Safety 2QH
(formerly 05.862) **Fall Quarter**

Accident prevention, accident cost analysis, federal and local legislation, record keeping requirements under OSHA Act of 1970; occupational safety and health standards, safety programs and inspections, fire prevention and control methods; human behavior and industrial safety, occupational diseases and personnel protective equipment. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3405 Technical Aspects of Health and Safety 2QH
(formerly 05.863) **Winter Quarter**

Safety responsibilities of management and employees; methods of hazard control; accident investigation; recognition of chemical, electrical and mechanical hazards; principles of machine guarding; occupational safety and health standards, safety training; toxicology and first aid and medical services. *Prep. IIS 3404 or permission of the instructor.*

IIS 3406 Man-Computer Interaction 2QH
(formerly 05.853) **Fall, Winter, and Spring Quarters**

Design and evaluation of the man-computer interface in on-line information systems; formatting of visual displays and auditory outputs, techniques to facilitate operator inputs, pacing and control of the interactive sequence, operator training, task analysis and performance testing. Student projects in areas of novel application. *Prep. IIS 3401.*

IIS 3407 Human Factors Engineering — Data Base 2QH
(formerly 05.854) **Winter Quarter**

The study of methods and techniques used to obtain and interpret human performance data. Includes examination of experimental methods and problems peculiar to experimentation with human subjects; unobtrusive measures, and non-reactive techniques, survey design and implementation, and systematic observation techniques. *Prep. IIS 3510.*

IIS 3408 Human Factors Engineering — Application Methods 2QH
(formerly 05.855) **Spring Quarter**

Systems analysis and man/machine systems; function and task analysis, task allocation, support equipment and training design, error analysis. Occupational safety; preconstruction, periodic; and accident/critical incident analytic techniques. *Prep. IIS 3102.*

IIS 3409 Topics in Physiology and Biomedical Engineering 2QH
(formerly 05.864) **Spring Quarter**

Introduction to specific areas relating to human structure and function, and to the use of engineering techniques for medical diagnosis and therapy. Areas considered include blood and blood com-

ponents, the cardiovascular system, the kidney and urinary systems and respiratory systems. The course will be taught on a seminar basis. Students will be required to do literature research under the guidance of the instructor. *Prep. Permission of instructor.*

IIS 3500 Principles of Dynamic Systems 4QH
Fall Quarter

Same material as IIS 3501 and 3502 offered as a 4 QH course. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3501 Principles of Dynamic Systems I 2QH
(formerly 05.906) **Winter Quarter**

Introduction to modeling of social systems, emphasizing the study of feedback structures and their behavior; development of concepts that allow one to understand the mechanisms underlying growth, stagnation and cyclical fluctuation; examples and practice at formulating models of industrial, economic, social, and ecological systems; study of some of the effects of delays, multiple feedback loops, and nonlinearities; aim to building an intuitive foundation for simulation studies of complex systems. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3502 Principles of Dynamic Systems II 2QH
(formerly 05.907) **Spring Quarter**

Continuation of topics from IIS 3501 with increased experience in the construction and analysis of generic feedback structures; examination of current and previous System Dynamics applications including Urban Dynamics and World Dynamics; exercises in model conceptualization. *Prep. IIS 3501.*

IIS 3503 Simulation Methodology and Applications 4QH
Winter Quarter

Same material as IIS 3504 and IIS 3505 offered as a 4 QH course. *Prep. IIS 3507 and compiler level language.*

IIS 3504 Analysis with Simulation 2QH
(formerly 05.905) **Fall Quarter**

Appropriate utilization of simulation as an effective quantitative analysis technique. Course covers when, where, and how to use discrete event simulation techniques. Topics include model design, development and validation, as well as tactical and strategic planning considerations in the use of the model to evaluate alternatives. Several special purpose simulation languages are discussed with emphasis and practical exercise using GPSS. Applications are drawn from both production and service industry settings. *Prep. Compiler level language, IIS 3507 or equivalent.*

IIS 3505 Simulation Methodology 2QH
(formerly 05.936) **Spring Quarter**

Consideration of concepts in modeling, input data reduction, alternative programming languages for

implementing models, model validation, efficiency in running simulations, and statistical reliability in the design and analysis of simulation experiments. Topics covered include: alternative approaches for simulation model control and their associated programming languages (e.g., SIMS-CRIPT, GPSS, and SIMAN); parametric and non-parametric statistical techniques for reduction of empirical data to appropriate form for model input and validation; tactical planning issues such as selection of initial conditions, variance reduction techniques, and efficient generation of random variates; and design and analysis of experiments with underlying assumptions appropriate to the simulation process. Computer exercises illustrating the theoretical concepts will be drawn from production and service-oriented industries. *Prep. IIS 3504.*

IIS 3506 Statistics **4QH**
Spring Quarter

Same material as IIS 3507 and IIS 3508 offered as a 4QH course. *Prep. IIS 3109.*

IIS 3507 Statistics I **2QH**
(formerly 05.962) Fall and Winter Quarters

Basic tools of statistical inference are covered. Limit theorems to include central limit, Chebyshev's Inequality, law of large numbers, point and interval estimators. Properties of estimators — bias, sufficiency, variance. Estimation by moments, max likelihood, Bayes. Hypothesis and hypothesis testing. One- and two-sided tests. Type I and Type II error. Power curve. Nonparametric tests such as goodness-of-fit tests and contingency tables. *Prep. IIS 3109.*

IIS 3508 Statistics II **2QH**
(formerly 05.963) Winter and Spring Quarters

Extensions of topics covered in IIS 3507 to develop more complete statistical models for prediction and analysis of random phenomena. Topics include multiple regression analysis, correlation, design and analysis of simple experiments, and nonparametric tests such as goodness of fit and contingency tables. *Prep. IIS 3507.*

IIS 3509 Design of Experiments **4QH**
Spring Quarter

Same material as IIS 3510 and IIS 3511 offered as a 4 QH course. *Prep. IIS 3508.*

IIS 3510 Design of Experiments I **2QH**
(formerly 05.964) Winter Quarter

An introduction to the theory and application of experimental design techniques such as modeling and statistics which can optimize resources and improve decision-making risks. This course will cover experiments with single and multiple factors of interest and consider restrictions imposed by various experimental conditions. *Prep. IIS 3508.*

IIS 3511 Design of Experiments II **2QH**
(formerly 05.965) Spring Quarter

A continuation of topics from IIS 3510 including further design techniques to handle experiments

with higher order experimental restrictions. Some additional analyses techniques will also be covered. *Prep. IIS 3510.*

IIS 3512 Queuing Theory and Its Applications **2QH**
(formerly 05.904) Spring Quarter

A development of the theory of queues with emphasis on practical applications, using the latest techniques of Markovian state-transition diagrams to simplify the mathematic model; study of models based on random arrivals and departures including exponential and Erlang service distributions, single and multiple services, series and parallel systems, finite and infinite queues; applications to staffing, inventory control, reliability, maintenance and scheduling. *Prep. IIS 3103 or IIS 3105.*

IIS 3513 Systems Engineering and Analysis **2QH**
(formerly 05.909) Spring Quarter

Principles of systems modeling using a transfer function approach; transient response and sensitivity of open and closed-loop systems; stability analysis; frequency response. Emphasis is on the most recent time-domain analysis methods using state-transition diagrams, and solving by computer using readily available computer algorithms. *Prep. Compiler level language.*

IIS 3514 Advanced Operations Research **4QH**
(formerly 05.914) Winter Quarter

Broad survey of important families of optimization methods, ranging from those applicable to the minimization of a single-variable function to those most suitable for large-scale nonlinear constrained problems. Individual algorithm applications to be selected and presented by the student with the instructor's approval. *Prep. IIS 3104 and IIS 3105 or IIS 3103.*

IIS 3515 Advanced Operations Research Topics **2QH**
(formerly 05.911) Fall Quarter

Important families of optimization methods will be surveyed. Topics covered will be a selected subset of the ones covered in IIS 3214. *Prep. IIS 3104 and 3105 or 3103 (credit cannot be granted for both IIS 3514 and IIS 3515).*

IIS 3516 Applied Topics in Operations Research **2QH**
(formerly 05.918) Spring Quarter

Selected applications from the material covered in IIS 3104 and IIS 3105. *Prep. IIS 3104 and IIS 3105.*

IIS 3517 Statistical Decision Theory **2QH**
(formerly 05.953) Fall Quarter

Use of Bayesian statistical inference to arrive at decisions when stochastic variables are interacting; relationship to game theory; decision making over time in a sequence; important expected values and distributions; relationship of Bayesian decision theory to classical statistical inference. *Prep. IIS 3507.*

IIS 3518 Advanced Quality Control 2QH
(formerly 05.954) Fall Quarter

Mathematical methods of quality control; development of the process control charts for sampling by variables and by attributes; development of acceptance test procedures; development of life-testing plans; cost aspects of quality-control decisions. *Prep. IIS 3507.*

IIS 3519 Reliability Theory in Design 2QH
(formerly 05.955) Winter Quarter

An introduction to the mathematical theory of the reliability of non-maintained systems and their application in the design of hardware and equipments in general; application of active and stand-by redundancy in systems; reliability predictions; stress-denoting techniques; availability concepts; design reviews and managerial control. *Prep. IIS 3507.*

IIS 3520 Reliability and Maintainability Assessment 2QH
(formerly 05.956) Winter Quarter

Engineering graphical and mathematical methods for reducing reliability test and field data; development and application of reliability and maintainability demonstration test plans and the economic aspects of each plan; maintainability predictions; managerial decisions. *Prep. IIS 3507.*

IIS 3521 Reliability Analysis of Complex Systems 2QH
(formerly 05.957) Spring Quarter

A Markovian-chain state-transition diagram approach to reliability modeling of non-maintained and maintained systems which permits analytic steady-state and dynamic solutions of both the stationary and non-stationary models; setting up the matrix-equations for solution by computer; controlling the numerical oscillations and accuracy of the results. *Prep. IIS 3519.*

IIS 3600 Basic Computer Systems Technology 2QH
(formerly 05.930) Fall and Winter Quarters

Introduction to computer systems and assembly language programming using a language such as VAX MACRO. Topics include: machine language, and assemblers. Input/output device control. Students are required to prepare and test several programs. *Prep. Compiler level language.*

IIS 3601 Compiler Design 4QH
Spring Quarter

Same material as IIS 3602 and IIS 3603 offered as a 4 QH course. *Prep. IIS 3600.*

IIS 3602 Compiler Design I 2QH
(formerly 05.931) Winter Quarter

An introduction to data structures including stacks and trees. The nature of compiling and interpreting, string manipulation and code generation. The writing of a compiler in assembly language of a BASIC-like source language will be started. *Prep. IIS 3600.*

IIS 3603 Compiler Design II 2QH
(formerly 05.932) Spring Quarter

The compiler design work started in IIS 3602 is completed as a term project. *Prep. IIS 3602.*

IIS 3604 Data Structures and Data Base Management 4QH

Winter Quarter

Same material as IIS 3605 and IIS 3606 offered as a 4 QH course. *Prep. IIS 3614 or IIS 3615.*

IIS 3605 Data Structures for Information Systems 2QH
(formerly 05.933) Winter Quarter

Treats the topics of computer files, file organization and processing, list and tree organization, maintenance controls, for quality, protection and security. *Prep. IIS 3614 or IIS 3615.*

IIS 3606 Data Base Management 2QH
(formerly 05.934) Spring Quarter

Introduction to data base systems and their rise in corporations. Review of basic data storage concepts. Evolution and growth of data bases. Data organization, file creation and management using hashing, threaded lists, tree structures. Distributed data bases. Data base software, directory maintenance, types of data base languages, query languages. Data base management systems. Data base administration. *Prep. IIS 3614 or IIS 3615.*

IIS 3607 Operating Systems and Systems Software 4QH
Fall Quarter

Same material as IIS 3608 and IIS 3609 offered as a 4 QH course. *Prep. IIS 3605, IIS 3611 and IIS 3600 or equivalent.*

IIS 3608 Operating Systems and Systems Software I 2QH
(formerly 05.945) Fall Quarter

A study of the components of operating systems including resource allocation management, multi-tasking, scheduling and I/O. Major software elements of a computer system are considered, including loaders, linkers, assemblers, compilers and interpreters. *Prep. IIS 3605, IIS 3611 and IIS 3600 or equivalent.*

IIS 3609 Operating Systems and Systems software II 2QH
(formerly 05.946) Winter Quarter

Continuation of IIS 3608. *Prep. IIS 3608.*

IIS 3610 Computer Architecture for Information Systems 4QH

Fall Quarter

Same material as IIS 3611 and IIS 3612 offered as a 4 QH course. *Prep. IIS 3600.*

IIS 3611 Computer Architecture for Information Systems I 2QH
(formerly 05.976) Fall Quarter

This course embodies how modern computers are designed and organized from a number of levels including the fundamental circuits memory, con-

trol and I/O as well as how alternative designs and architectures affect and are affected by software. Topics to be covered include: elementary digital circuits including registers, multiplexers and circuits used in arithmetic operations, control and I/O; memory organization; microprogramming; busses and I/O channels; example architectures including PDP 11, IBM 360/370 and a typical microprocessor; multitasking; virtual systems. *Prep. IIS 3600 or equivalent.*

IIS 3612 Computer Architecture for Information Systems II **2QH**
(formerly 05.977) **Winter Quarter**
Continuation of IIS 3611. *Prep. IIS 3611.*

IIS 3613 Principles of Software Design **2QH**
(formerly 05.947) **Winter Quarter**
Examines techniques for solving complex computer programming tasks with special attention to the technological and organizational factors affecting information system building. Topics include run-time structures in programming languages, communication, linking, and sharing of programs and data; also, interface design, program documentation, maintenance modification, testing and debugging. Current topics in program design such as readability, data abstraction, step-wise refinement and structured program are also covered. *Prep. IIS 3608 and IIS 3609 or IIS 3607.*

IIS 3614 Basic Information System Technology **2QH**
(formerly 05.940) **Fall, Winter, and Spring Quarters**

Introduction to the hardware and software which support computer-based management information systems, design, development, and operation. Topics include basic computer concepts such as binary number systems, and CPU instruction cycle; data conversion and data entry devices; secondary memory types; output and display devices; and the nature of machine-oriented and high-level computer languages. Objective of the course is to provide sufficient knowledge regarding these concepts and equipment characteristics to permit specification of software and equipment configuration appropriate to support a given set of management information needs. *Prep. Bachelor of Science degree in Engineering or Science.*

IIS 3615 Analysis and Design of Computer Information Systems **4QH**
Fall Quarter

Introduction to computer information systems analysis and design techniques and the hardware and software which support such systems. Topics covered include: tools and techniques for determining information requirements for MIS/DSSs; development of the functional systems design; and computer system design considerations such as the CPU, main memory, operating systems functions, computer languages, input devices, secondary memory, file organization, data-base

management systems, data communications, data security, and output and display devices. The main objective of the course is to provide sufficient knowledge to permit skeletal design of the computer system to support a given set of management needs. *Prep. Admission to the Graduate School of Engineering.*

IIS 3616 MIS: Planning and Managing the Contributions to the Decision Process **4QH**
Spring Quarter

Same material as IIS 3617 and IIS 3618 offered as a 4QH course. *Prep. IIS 3614 or IIS 3615.*

IIS 3617 Management Information Systems **2QH**

(formerly 05.941) **Fall and Winter Quarters**
The development of a conceptual framework which emphasizes support to management decision making. Relevant cognitive and organizational characteristics of human decision making are integrated into a systems analysis approach to development of effective information systems. Case study discussions are used extensively to apply principles to realistic situations. *Prep. Bachelor of Science degree in Engineering or Science. Prep. IIS 3614 or IIS 3615.*

IIS 3618 MIS: Planning, Control and Development **2QH**

(formerly 05.942) **Winter and Spring Quarters**
Phases of MIS design and development are examined from a planning and control viewpoint. Techniques are presented for conceptual identification of a continuing stream of information system candidate projects, for achieving a user-oriented assessment of cost/benefit potential, and for control of the design and implementation effort. Case study discussions are used extensively to apply principles to realistic situations. *Prep. IIS 3614 or IIS 3615.*

IIS 3619 Networks and Telecommunications **2QH**

(formerly 05.943) **Spring Quarter**
Develops the trade-offs in performance between centralized systems utilizing large-scale hardware installations and distributed systems utilizing minicomputers. Trade-offs are in terms of MIS performance capabilities, software development costs and lead times, management control, documentation and maintenance times and cost. Discussion of hardware is at the conceptual level of data flow and processing performance. *Prep. IIS 3614 or IIS 3615.*

IIS 3620 Computerized Financial Control Systems **2QH**

(formerly 05.944) **Spring Quarter**
Considers on-line systems for financial and inventory control from the technological, legal, and social point of view. The focus of the course is on electronic funds transfer (EFT) and point of sale (POS) terminals and associated computing equipment for inter-bank and consumer banking trans-

actions, debit card transactions, and retail management information systems to control cash and inventory. The current technological status and societal implications of EFT and POS terminals are discussed. *Prep. IIS 3614 or IIS 3615.*

IIS 3621 Information Systems and Society

2QH

(formerly 05.948) Fall and Winter Quarters

Discussion of the role computer systems play in modern society. The beneficial use of computers in commercial and industrial enterprises is considered and contrasted with the potential for infringement of individual privacy rights. Sufficient technical material on computer hardware, software, and data communications is discussed to permit assessment of system feasibility. Relevant major legislation is related to current practice in use of computer systems. *Prep. Admission to Graduate School.*

IIS 3622 Information Systems Environment

4QH

Spring Quarter

Explores the role of individual microcomputers and networks of microcomputers and larger machines in providing decision-aiding information. Topics covered include: elements of office automation, local area networks, data communications, and micro and minicomputer-based decision support software. Emphasis is placed on application of software packages to case problems. The hardware to be utilized will be primarily IBM PCs or IBM PC compatible machines. Some use will be made of the VAX 11/780 for contrasting the power of microcomputers with that of a super minicomputer for a given task such as data-base management. Specific IBM software planned to be used includes: KnowledgeMan, Superwriter, Lotus 1-2-3, dBase II, and Number Cruncher. On the VAX 11/780, exposure to Runoff, INGRES, and DATATRIEVE will be provided. *Prep. IIS 3614.*

IIS 3623 File Processing

2QH

(formerly 05.938) Winter Quarter

Processing of sequential, indexed-sequential, and direct/relative data files on tape and disk; record blocking, searching, sorting, and merging operations; random access techniques; introduction to data base management concepts, and if time permits an introduction to RPG. *Prep. Knowledge of COBOL programming.*

IIS 3650 Engineering Analysis Utilizing Data Processing

2QH

(formerly 05.916) Spring Quarter

Application of computers and major high-level computer languages to the solution of engineering problems. FORTRAN and GPSS are employed in applications drawn from production and ser-

vice-oriented industries to illustrate topics such as generation of random numbers, inventory simulation models, file search and sorting techniques, and root-finding algorithms. The standard software packages of SPSS and MPOS are introduced. *Prep. Compiler level language.*

IIS 3797 Engineer Degree Continuation **0QH** **Any Quarter**

IIS 3798 Master's Thesis Continuation **0QH** **(formerly 05.9X1) Any Quarter**

IIS 3799 PhD Continuation **0QH** **(formerly 05.9X5) Any Quarter**

IIS 3801 Special Project in Industrial Engineering **2QH or 4QH** **(formerly 05.993) Any Quarter**

Individual work under faculty supervision. *Prep. Consent of adviser.*

IIS 3803 Independent Study in Operations Research **2QH** **(formerly 05.919) Any Quarter**

Special topics in Operations Research by arrangement with a faculty member.

IIS 3804 Special Topics **4QH** **Any Quarter**

Special topics in IE and IS. *Prep. Permission of instructor.*

IIS 3805 Special Topics **2QH** **Any Quarter**

Special topics in IE and IS. *Prep. Permission of instructor.*

IIS 3806 Seminar in Industrial Engineering **2QH** **(formerly 05.992) Any Quarter**

Discussion and presentations of thesis-related topics by students, presentations and discussions by faculty and eminent people in the field on timely industrial engineering topics. Field trips and visitations included where appropriate. *Prep. Permission of instructor.*

IIS 3860 Thesis (Master's Degree) **6QH** **(formerly 05.991) Any Quarter**

Analytical and/or experimental work conducted under the auspices of the Department. *Prep. Consent of adviser.*

IIS 3870 Industrial Engineer Degree Project **10QH** **(formerly 05.994) Any Quarter**

Undertaken with the approval of the candidate's adviser and the Department Graduate Committee.

IIS 3880 Doctoral Thesis **Any Quarter**

Doctoral thesis research conducted under advis-
ership of the doctoral student's dissertation com-
mittee. *Prep: Admission to doctoral candidacy.*

Mechanical Engineering

Each course description includes information on the expected quarter in which classes are usually offered. The quarters listed are presented here for planning purposes; however, the Graduate School of Engineering cannot guarantee that all courses will be offered. Students must refer to the Graduate School of Engineering Quarterly Course Offering sheets to determine what courses are actually offered in any given quarter and at what day and time. 'Odd' and 'Even' years refer to the fall quarter of the academic year, i.e., Spring '85 which is in the 84-85 academic year, would be an 'Even' year.

ME 3100 Mathematical Methods for Mechanical Engineers **4QH**
(formerly 02.825) **Fall Quarter**
Embodies the material in ME 3101 and ME 3102. *Prep. Admission to the Graduate School of Engineering.*

ME 3101 Mathematical Methods for Mechanical Engineers I **2QH**
(formerly 02.826) **Fall Quarter**
Bessel and Legendre functions: boundary-value problems and series of orthogonal functions. Partial differential equations and applications to heat transfer, fluid flow, vibrations and wave propagation. *Prep. Admission to the Graduate School of Engineering.*

ME 3102 Mathematical Methods for Mechanical Engineers II **2QH**
(formerly 02.827) **Winter Quarter**
Vector analysis; divergence theorem; functions of a complex variable; Laurent series and singular points; residues and contour integration; applications. *Prep. Admission to the Graduate School of Engineering.*

ME 3120 Theory of Elasticity **4QH**
(formerly 02.807) **Fall Quarter**
Embodies the material in ME 3121 and ME 3122. *Prep. Admission to the Graduate School of Engineering.*

ME 3121 Theory to Elasticity I **2QH**
(formerly 02.804) **Fall Quarter**
Analysis of Cartesian tensors using indicial notation. Stress and strain concepts; point stress and strain; relation to tensor concepts. Governing equations for the determination of stress and displacement distributions in a solid body. Exact solutions of the governing equations for elastic solids. *Prep. Admission to the Graduate School of Engineering.*

ME 3122 Theory of Elasticity II **2QH**
(formerly 02.805) **Winter Quarter**
Plane stress and strain problems in rectangular and polar coordinates including thermal stress. Relation of elasticity theory to strength of materials. Torsion of prismatic and axially symmetric bars. Bending of thin flat rectangular and circular plates. *Prep. ME 3121.*

ME 3140 Advanced Dynamics **4QH**
Fall Quarter
Embodies the material in ME 3141 and ME 3142. *Prep. Admission to the Graduate School of Engineering.*

ME 3141 Advanced Dynamics I **2QH**
(formerly 02.847) **Fall Quarter**
Kinematics of particles and rigid bodies. Modeling and application of fundamental laws of motion. Dynamic response of lumped parameter systems. *Prep. Admission to the Graduate School of Engineering.*

ME 3142 Advanced Dynamics II **2QH**
(formerly 02.848) **Winter Quarter**
Continuation of ME 3141. Lagrange's equations. Applications in two and three dimensions. *Prep. ME 3141.*

ME 3200 General Thermodynamics **4QH**
(formerly 02.903) **Winter Quarter**
Fundamentals of equilibrium thermodynamics will be examined. Topics include: work, energy, heat, temperature, available energy, entropy, first and second laws of thermodynamics, simple systems, closed and open systems, availability loss and irreversibility, heat engines, multicomponent systems, mixtures of gases, chemical reactions and chemical equilibrium. Equivalent to courses ME 3201 and ME 3202. *Prep. Admission to the Graduate School of Engineering.*

ME 3201 General Thermodynamics I **2QH**
(formerly 02.901) **Fall Quarter**
ME 3201 and ME 3202 present the same material contained in ME 3200 but in two 2QH courses. *Prep. Admission to the Graduate School of Engineering.*

ME 3202 General Thermodynamics II **2QH**
(formerly 02.902) **Winter Quarter**
Continuation of ME 3201. *Prep. ME 3201.*

ME 3210 Essentials of Fluid Dynamics **4QH**
(formerly 02.821) **Fall Quarter**
This is a fundamental course in fluid dynamics designed to prepare the student for more advanced courses in the thermofluids curriculum while providing a strong background in fluid mechanics. Topics to be covered may include: Cartesian tensors; differential and integral formulation of the equations of conservation of mass, momentum and energy; molecular and continuum transport phenomena; The Navier-Stokes equations; Vorticity; inviscid, incompressible flow, the velocity potential and Bernoulli's equation; viscous incompressible flow; the stream function; some exact solutions; energy equation including heat conduction and viscous dissipation. This material is also covered in the two 2QH courses ME 3211 and ME 3212. *Prep. Admission to the Graduate School of Engineering.*

ME 3211 Essentials of Fluid Dynamics I 2QH
(formerly 02.819) **Fall Quarter**

ME 3211 and ME 3212 present the same material with the same prerequisites as ME 3210, but in two 2QH courses. *Prep. Admission to the Graduate School of Engineering.*

ME 3212 Essentials of Fluid Dynamics II 2QH
(formerly 02.820) **Winter Quarter**

Continuation ME 3211. *Prep. ME 3211.*

ME 3250 Advanced Physical Metallurgy I 2QH
(formerly 02.953) **Fall Quarter, Odd Years**

The kinetics of phase transformations in metals. Topics include kinetic theory, empirical kinetics, diffusion in metals, nucleation, diffusional growth, martensitic transformations. *Prep. A recent introductory material science course.*

ME 3251 Advanced Physical Metallurgy II 2QH
(formerly 02.954) **Winter Quarter, Odd Years**

Dislocation theory; including such topics as dislocation stress fields, self-energy, velocity, interactions mechanisms, image forces, and theories of yielding. *Prep. A recent introductory material science course.*

ME 3260 Thermodynamics of Materials I 2QH
(formerly 02.960) **Fall Quarter, Odd Years**

Basic metallurgical thermodynamics encompassing first, second, and third laws, entropy, enthalpy, and free energy. *Prep. Engineering materials.*

ME 3261 Thermodynamics of Materials II 2QH
(formerly 02.961) **Winter Quarter, Odd Years**

Continuation of ME 3260 with emphasis on solutions, activity, activity coefficients, the phase rule and applications to some metallurgical problems. *Prep. ME 3260.*

ME 3270 Material Science and Engineering I 2QH
(formerly 02.970) **Fall Quarter, Even Years**

Principles underlying the structure and properties of solid materials. The relationships of these principles to the properties and to applications in structures and devices. Both macroscopic-phenomenological and electronic-molecular approaches will be used. Materials will include metals and alloys, semiconductors, and dielectrics. Typical subjects are atomic and electronic structures, ordering, nucleation, crystal growth, and thermal properties. *Prep. A recent introductory material science course.*

ME 3271 Material Science and Engineering II 2QH
(formerly 02.971) **Winter Quarter, Even Years**

Continuation of ME 3270 into additional topics such as electric, magnetic, and optical properties; applications of solid-state phenomena to achieve functions embodied in transducers, filters, amplifiers, energy converters, and so forth. *Prep. ME 3270.*

ME 3341 Power Generating Systems I 2QH
(formerly 02.935) **Fall Quarter**

Power generating systems that employ fossil, nuclear, and heat recovery boilers operating in conjunction with steam and organic Rankine cycles are examined. The steady-state and transient operation of each power-generating system is studied from both an analytical and conceptual point of view. The effect that site conditions, fuel quality, plant loading schedule and environmental regulations have on system design, performance and operation is presented. *Prep. ME 3200 or equivalent, or may be taken concurrently with permission of instructor.*

ME 3342 Power Generating Systems II 2QH
(formerly 02.936) **Winter Quarter**

An extension of ME 3341. The same type of examination is conducted of systems incorporating gas, hydraulic, and wind turbines, solar and fuel cells, energy storage, combined cycles, and cogenerating systems. The objective of Power Generating Systems I and II is to develop the skills needed to conduct sound technical evaluations of the power generating systems being built today. *Prep. ME 3341.*

ME 3343 Power Generation Economics and Planning 2QH
(formerly 02.938) **Spring Quarter**

Current and constant-dollar power generation costs are examined. Life-cycle economic analysis, such as revenue requirements, discounted cash flow, internal rate of return, and payback analyses are presented. The planning methodologies used by electric utilities and private industry to evaluate and select power generating systems are presented. *Prep. ME 3342.*

ME 3351 Solar Thermal Engineering I 2QH
(formerly 02.855) **Fall Quarter, Odd Years**

A model is developed for the hourly direct and diffuse radiation under a cover of scattered clouds and the transmission and absorption of this radiation by passive and active systems. The design of air heating systems and the storage of the collected energy by a pebble-bed are considered, as well as elements of heat exchanger design. A study of the economics of a domestic water and/or space heating system is made using f-chart analysis. *Prep. CHE 3659, Solar Energy Thermal Processes or equivalent background.*

ME 3352 Solar Thermal Engineering II 2QH
(formerly 02.856) **Winter Quarter, Odd Years**

The design and analysis of several solar thermal systems are considered, such as: LiBr-H₂O absorption cooling units, heat pumps, compound parabolic collectors, and the heat pipe type of solar collector. *Prep. ME 3351.*

ME 3361 Turbomachinery Design I **2QH**
(formerly 02.930) **Fall Quarter**

Preliminary design methods and analytical tools applicable to turbomachinery in general, including velocity diagram selection and limitations of diffusion, are presented. Design criteria and performance characteristics at design and off-design operating conditions are discussed for several important types of turbomachinery. Axial flow compressors and turbines (gas and steam) are studied in some depth, including topics such as compressor surge, turbine blade cooling, and steam wetness effects. Centrifugal compressors, radial inflow turbines, pumps, fans, and water turbines are also studied. Turbomachinery mechanical design limitations are discussed. The use of empirical data on blade cascade performance in blade selection is examined. Numerical methods of analyzing two- and three-dimensional flows in turbomachinery (e.g., conformal transformation and streamline curvature) are presented. Two in-depth design projects (one per quarter) are assigned. *Prep. Admission to the Graduate School of Engineering, and undergraduate preparation in fluid mechanics and thermodynamics.*

ME 3362 Turbomachinery Design II **2QH**
(formerly 02.931) **Winter Quarter**
Continuation of ME 3361. *Prep. ME 3361.***ME 3380 Fundamentals of Instrumentation** **2QH**
(formerly 02.853) **Fall Quarter**

Theoretical principles underlying the design and operation of instruments for measurement and/or control. Analysis of stimulus-response relations. Industrial instruments for measurement and control, including those based on pneumatic and electrical systems. *Prep. Bachelor of Science degree.*

ME 3381 Industrial Process Control **2QH**
(formerly 02.854) **Winter Quarter**
Fundamental principles involved in automatic control of industrial processes. Economic considerations. Application of control instruments to obtain automatic control of temperature, pressure, fluid flow, liquid level, humidity, PH. *Prep. ME 3380.***ME 3386 Nuclear Engineering I** **2QH**
(formerly 02.942) **Fall Quarter, Even Years**
Topics include: growth of nuclear power industry; study of nuclear physics emphasizing atomic and nuclear structure, radioactive decay, and nuclear reactions with particular attention to fission and fusion; radiation health physics; principles of shielding; nuclear instrumentation; production and application of radioisotopes; neutron interactions and slowing down theory; neutron activation analysis. (Not open to students who have completed ME 1541 and ME 1542). *Prep. Admission to the Graduate School of Engineering.***ME 3387 Nuclear Engineering II** **2QH**
(formerly 02.943) **Winter Quarter, Even Years**
Comparison of thermal, fast, and breeder reactors; four factor formula and the neutron diffusion equation; one-group, modified one-group, two-group and multi-group theory; bare and reflected thermal reactors; energy production and distribution within core; flux shaping; transient reactor behavior and control; factors affecting reactivity including temperature, pressure, void formation, fission product accumulation, fuel depletion and fuel breeding; Xenon buildup after shutdown. (Not open to students who have completed ME 1541 and ME 1542). *Prep. ME 3386.***ME 3388 Nuclear Engineering III** **2QH**
(formerly 02.944) **Spring Quarter, Even Years**
Reactor design considerations; interrelationship of reactor physics, control, engineering, materials, safety, and fuel cycle management; reactor types; radiation damage and reactor materials; nuclear fuels; reactor heat transfer; economics of nuclear power; environmental effects. (Not open to students who have completed ME 1541 and ME 1542). *Prep. ME 3387.***ME 3401 Advanced Math Methods for Mechanical Engineers I** **2QH**
(formerly 02.828) **Spring Quarter, Even Years**
Matrices and linear equations. Variational calculus and applications. Approximate methods of engineering analysis. Selected topics of current interest. *Prep. ME 3101 and ME 3102.***ME 3402 Advanced Math Methods for Mechanical Engineers II** **2QH**
Spring Quarter, Odd Years
Integral transforms; asymptotic expansion; regular and singular perturbation methods. Examples drawn from solid mechanics, vibration, and fluid mechanics. *Prep. ME 3101 and ME 3102.***ME 3410 Numerical Methods in Mechanical Engineering** **4QH**
All Winter Quarters. Fall Quarter, Even Years
Numerical methods applied to problems in mechanical engineering. Solution of linear and nonlinear systems of equations, interpolation, numerical differentiation and integration, numerical solution of ordinary differential equations: explicit and implicit methods, multistep methods, predictor-corrector methods. Numerical solution of partial differential equations with emphasis on parabolic and elliptic problems occurring in mechanical engineering. This material is also covered in the two 2QH courses ME 3411 and ME 3412. *Prep. ME 3100.***ME 3411 Numerical Methods in Mechanical Engineering I** **2QH**
As Announced
ME 3411 and ME 3412 present the same material with the same prerequisites as ME 3410, but in two 2QH courses.

ME 3412 Numerical Methods in Mechanical Engineering II **2QH**
As AnnouncedContinuation of ME 3411. *Prep. ME 3411.***ME 3420 Mechanics of Inelastic Solids** **4QH**
Spring QuarterConstitutive relations governing inelastic solids. Yield surface; plastic stress-strain relations; Prandtl-Reuss equations. Viscoelastic stress-strain relations including the Maxwell and Voigt models. Viscoplasticity. *Prep. ME 3122. Not available to students who have taken ME 3421.***ME 3421 Introduction to Plasticity** **2QH**
(formerly 02.809) Winter Quarter, Even YearsBasic experimental information. Review of stress and strain tensors. Elastic stress-strain relations. Yield surface. Plastic stress-strain relations. Prandtl-Reuss equations. Simple applications. *Prep. ME 3121.***ME 3423 Theory of Elasticity** **2QH**
(formerly 02.806) Spring QuarterApproximate solutions for stress and displacement distributions in elastic solids; discrete solutions using finite difference and finite element methods; energy principles and the calculus of variations; use of energy principles to obtain approximate continuous solutions. *Prep. ME 3122, Theory of Elasticity II.***ME 3432 Engineering Fracture Mechanics I****(formerly 02.838) Fall Quarter, Odd Years** **2QH**Fundamentals of brittle fracture; theoretical strength, micro/macro fracture characteristic, Inglis-Griffith theory, applicability of same. Linear elastic fracture mechanics; Orowan/Irwin extension to metals, effective surface tension and relation to fracture toughness, plastic zone size correction; geometry effects on fracture toughness; plane strain/plane stress fracture toughness, thickness effects. *Prep. ME 3122.***ME 3433 Engineering Fracture Mechanics II****(formerly 02.839) Winter Quarter, Odd Years** **2QH**Experimental determination of fracture toughness; slow crack growth "pop in," arrest, R-G curves, compliance techniques for determining elastic energy release rate. Alternate fracture toughness concepts; resistance curve, crack opening displacement, the J integral. Application of fracture mechanics to fatigue. Design methods to minimize risks of catastrophic failure will be emphasized. *Prep. ME 3432.***ME 3434 Engineering Fracture Mechanics III****(formerly 02.829) Spring Quarter, Odd Years** **2QH**

Application of fracture mechanics to fatigue, strain energy density criteria for fracture, arrest criteria. "Work of Fracture" specimen. Application of fracture mechanics to structural analysis. Effect of anisotropy in fracture mechanics. Fracture

dynamics, dynamic fracture toughness, strain rate effects. Microsecond fracture phenomenon and criteria, spall, Butcher-Tuler criterion, NAG model. Residual strength, design approaches will be emphasized. *Prep. ME 3433.***ME 3440 Advanced Mechanics of Materials****(formerly 02.812) Winter Quarter** **4QH**Embodies the material in ME 3441 and ME 3442. *Prep. Admission to the Graduate School of Engineering.***ME 3441 Advanced Mechanics of Materials I****(formerly 02.810) Fall Quarter** **2QH**Review of fundamental stress and deformation concepts; strain energy density; introduction to energy methods with application to beams, frames and rings; Ritz method. *Prep. Admission to the Graduate School of Engineering.***ME 3442 Advanced Mechanics of Materials II****(formerly 02.811) Winter Quarter** **2QH**Beams on elastic foundations. Concept of stability as applied to one and two degree-of-freedom systems. Buckling of bars, frames and rings. *Prep. ME 3441.***ME 3443 Advanced Mechanics of Materials III****(formerly 02.813) Spring Quarter, Even Years** **2QH**Selected topics in advanced mechanics; will vary with current interest. *Prep. ME 3442, Advanced Mechanics of Materials II or consent of the instructor.***ME 3446 Theory of Shells****(formerly 02.815) Spring Quarter, Odd Years** **2QH**Membrane theory of shells. Analysis of cylindrical shells. General theory of thin elastic shells. Shells of revolution. *Prep. ME 3122.***ME 3455 Mechanics of Composite Materials****(formerly 02.816) Winter Quarter, Odd Years** **2QH**Constitutive equations for anisotropic laminated composite materials, and application to the structural response of beams and plates. Bending and buckling of symmetric and nonsymmetric laminates. *Prep. ME 3121.***ME 3465 Automatic Control Engineering A****(formerly 02.849) Fall Quarter, Even Years** **2QH**Concepts of feedback control; formulation of equations, transfer functions, and block diagrams representing components and systems; linearization; Laplace transformation; stability. *Prep. Admission to the Graduate School of Engineering.***ME 3466 Automatic Control Engineering I** **2QH****(formerly 02.850) Winter Quarter, Even Years**Study of control action; analysis and design by use of root-locus and frequency-domain techniques. *Prep. ME 3465 or permission of instructor.*

ME 3467 Automatic Control Engineering II**2QH****(formerly 02.851) Spring Quarter, Even Years**

Further consideration of linear systems including compensation methods and multiple-input. Techniques for the treatment of nonlinear systems. *Prep. ME 3466.*

ME 3468 Robot Mechanics and Control **4QH**
Spring Quarter

Kinematics and dynamics of robot manipulators are the focus of the first part of the course. Kinematics cover the development of kinematic equations of manipulators, the inverse kinematic problems, and motion trajectories. Dynamics of manipulators for the purpose of control are covered employing Lagrangian mechanics. The second part of the course focuses on the control and programming of robot manipulators. Steady state errors and calculations of servo parameters are covered. High level programming languages are discussed. *Prep. ME 3142.*

ME 3470 Vibration Theory and Applications**4QH****(formerly 02.844)****Winter Quarter**

Embodies the material in ME 3472 and ME 3473. *Prep. ME 3142 or ME 3471.*

ME 3471 Vibration Theory and Applications A**2QH****(formerly 02.841)****As Announced**

Modeling of vibratory systems; one-degree-of-freedom systems (determination of equations of motion using free-body and energy methods); forced and free vibrations through two degrees of freedom. *Prep. Admission to the Graduate School of Engineering.*

ME 3472 Vibration Theory and Applications I**2QH****(formerly 02.842)****Fall Quarter, Odd Years**

Laplace transformation techniques; phase-plane diagrams; multiple-degree-of-freedom systems; free and forced vibrations with and without damping. *Prep. ME 3471 or ME 3142.*

ME 3473 Vibration Theory and Applications II**2QH****(formerly 02.843)****Winter Quarter, Odd Years**

Systems with distributed mass and stiffness. Extensional, torsional and flexural vibrations of bars. *Prep. ME 3472.*

ME 3474 Vibration Theory and Applications III**2QH****(formerly 02.846)****As Announced**

Selected topics of current interest in vibrations. *Prep. ME 3473.*

ME 3475 Random Vibration**2QH****(formerly 02.845)****Spring Quarter, Odd Years**

Description of stochastic processes. Impulse response and frequency response of linear time-invariant dynamic systems. Correlations and spectra of stationary response. Crossing rates, peaks

and envelopes. Failure under random loading. Poisson pulse processes. Measurement, identification, and response problems. Coherence. Space-time correlations and cross-spectra. Digital data processing. Application to vehicles and structures subjected to wide-band excitation. *Prep. ME 3473.*

ME 3480 The Finite Element Method**4QH****(formerly 02.949)****Spring Quarter**

Embodies the material in ME 3481 and ME 3482. *Prep. ME 3101 and ME 3102 or consent of the instructor.*

ME 3481 Finite Element Analysis**2QH****(formerly 02.840)****Fall Quarter**

Introduction to the finite element method. Variational formulations; simple interpolation functions and element stiffness matrices. Triangular and rectangular elements. Assembly technique and constraining of resulting equations. Elementary applications. *Prep. ME 3101 and ME 3102 or consent of the instructor.*

ME 3482 Advanced Finite Element Method I**2QH****(formerly 02.947)****Winter Quarter**

Isoparametric element formulation of higher-order and three-dimensional elements. Rayleigh-Ritz and Galerkin formulations. Applications of finite element theory to mechanical engineering problems in the areas of solid mechanics, heat transfer, and fluid mechanics. The use of a finite element general purpose commercial package is included. *Prep. ME 3481.*

ME 3483 Advanced Finite Element Method II**2QH****(formerly 02.948) Spring Quarter, Even Years**

The dynamic finite element formulation with explicit and implicit time integration schemes for transient analysis. Solution methods for finite element equilibrium equations, including material and geometrical nonlinearities. The general structure of computer procedures and codes. Influence of computer-aided design technology. Use of an in-house general purpose commercial code is included. *Prep. ME 3482.*

ME 3500 Computer-Aided Graphics and Design**4QH****Winter Quarter**

Basic aspects of interactive computer graphics are covered. Topics include hardware and software concepts, design principles for the user-computer interface, geometrical transformation, display architecture, and data structures. Algorithms for removing hidden edges and surfaces, shading models, and intensity and colors are also covered. The second part of the course deals with the concepts of computational and numerical geometry and design of curves and surfaces. Solid modeling techniques are presented. Discussions of in-house computer-aided graphics and design

packages are included. *Prep. Admission to the Graduate School of Engineering and programming experience.*

ME 3540 Heat Conduction and Thermal Radiation **4QH**
(formerly 02.910 and 02.913) **Winter Quarter**

Formulation of steady and unsteady state one- and multidimensional heat conduction problems. Solution techniques for linear problems including the method of separation of variables, Laplace transforms and integral transforms. Approximate analytical methods. Phase change problems. Non-linear problems. Nature of thermal radiation. Blackbody and radiation from a blackbody. Radiation from a nonblack surface element. Radiative exchange among surfaces separated by a nonparticipating medium. Interaction of radiation with other modes of heat transfer in nonparticipating media. Numerical techniques in heat transfer are covered in ME 3410. Engineering. This material is also covered in the two 2QH courses ME 3541 and ME 3542. *Prep. ME 3100 and undergraduate course in heat transfer.*

ME 3541 Heat Conduction and Thermal Radiation I **2QH**
(formerly 02.910) **Fall Quarter**

ME 3541 and ME 3542 present the same material with same prerequisites as ME 3540, but in two 2QH courses.

ME 3542 Heat Conduction and Thermal Radiation II **2QH**
(formerly 02.913) **Winter Quarter**

Continuation of ME 3541. *Prep. ME 3541.*

ME 3544 Convective Heat Transfer **4QH**
(formerly 02.911)

Winter Quarter, Even Years; Fall Quarter, Odd Years

Fundamental equations of convective heat transfer. Heat transfer in incompressible external laminar boundary layers. Integral boundary layer equations. Laminar forced convection in internal flows. Turbulent forced convection in internal and external flows. Analogies between heat and momentum transfer; the Reynolds, Taylor and Martinelli analogies. Natural convection. Heat transfer in high-speed flow. Transient forced convection. Convection and radiation in nonparticipating media. This material is also covered in the two 2QH courses ME 3545 and ME 3546. *Prep. ME 3100, ME 3210 and an undergraduate course in Heat Transfer.*

ME 3545 Convective Heat Transfer I **2QH**
(formerly 02.911) **As Announced**

ME 3545 and ME 3546 present the same material with the same prerequisites as ME 3544, but in two 2QH courses.

ME 3546 Convective Heat Transfer II **2QH**
(formerly 02.911) **As Announced**

Continuation of ME 3545. *Prep. ME 3545.*

ME 3548 Radiative Transfer **4QH**
Spring Quarter, Odd Years

Electromagnetic background. Fundamentals of radiation in absorbing, emitting and scattering media. Equation of radiative transfer. Approximate methods in the solution of the equation of radiative transfer. Singular-eigenfunction expansion technique. Pure radiative transfer in participating media. Interaction of radiation with conduction and/or convection. The Monte Carlo technique. This material is also covered in the two 2QH courses ME 3549 and ME 3550. *Prep. ME 3540.*

ME 3549 Radiative Transfer I **2QH**
As Announced

ME 3549 and ME 3550 present the same material with the same prerequisites as ME 3548, but in two 2QH courses.

ME 3550 Radiative Transfer II **2QH**
As Announced

Continuation of ME 3549. *Prep. ME 3549.*

ME 3552 Two Phase Flow **4QH**
Winter, Odd Years

This course is aimed at the understanding of the basic concepts of heat and mass transfer associated with phase change and multiphase flows. Some of the specific subjects to be discussed are: boiling heat transfer (nucleate boiling, film boiling and bubble dynamics); evaporation and condensation; liquid-gas two phase flow and gas-solid and liquid-solid two phase flows. This material is also covered in the two 2QH course ME 3553 and ME 3554. *Prep. ME 3100 (or equivalent) and undergraduate heat transfer.*

ME 3553 Two Phase Flow I **2QH**
As Announced

ME 3553 and ME 3554 present the same material as ME 3552 with the same prerequisites but in two 2QH courses.

ME 3554 Two Phase Flow II **2QH**
As Announced

Continuation of ME 3553. *Prep. ME 3553.*

ME 3556 Heat Transfer Processes in Microelectronic Devices **4QH**
Spring Quarter

The course will discuss and develop state-of-the-art methods used to predict the heat transfer rates from microelectronic devices and packages and to simulate transport phenomena in manufacturing processes associated with microelectronic devices. Topics will be selected from the current literature and may include use of latent heat reservoirs, boiling jet impingement cooling, control volume approaches to extended surfaces, calculation of thermal contact conductances and natural convection in enclosures. Simulation of laser-assisted thermophoretic deposition and laser cladding processes will also be developed. This material is also contained in the two 2QH courses

ME 3557 and ME 3558. *Prep. ME 3100 (or equivalent) and undergraduate heat transfer or consent of instructor.*

ME 3557 Heat Transfer Processes in Microelectronic Devices I **2QH**
As Announced

ME 3557 and ME 3558 provide the same material as ME 3556 with the same prerequisites, but in two 2QH course.

ME 3558 Heat Transfer Processes in Microelectronic Devices II **2QH**
As Announced

Continuation of ME 3557. *Prep. ME 3557.*

ME 3560 Viscous Flow **4QH**
Spring Quarter, Odd Years

Review of conservation of mass, momentum, and energy for compressible viscous flow. Discussion of the mathematical character of the basic equations and analysis of some exact solutions. Investigation of low Reynolds number flow. Exact and approximate approaches to laminar boundary layers in high Reynolds number flows. Stability of laminar flows and the transition to turbulence. Treatment of incompressible turbulent mean flow; internal and external flows. Extensions to compressible boundary layers. This material is also covered in the two 2QH courses ME 3561 and ME 3562. *Prep. ME 3100 and ME 3210.*

ME 3561 Viscous Flow I **2QH**
As Announced

ME 3561 and ME 3562 present the same material with the same prerequisites as ME 3560, but in two 2QH courses.

ME 3562 Viscous Flow II **2QH**
As Announced

Continuation of ME 3561. *Prep. ME 3561.*

ME 3564 Gas Dynamics **4QH**
(formerly 02.823 and 02.824)

Spring Quarter, Even Years

The consequences of fluid compressibility are studied. Shock waves and the theory of characteristics are discussed with specific consideration given to two-dimensional steady flows and one-dimensional unsteady flows. Additional topics may include axially symmetric steady flow, small perturbation theory, similarity rules, the hodograph method, or some aspects of physical acoustics. This material is also contained in the two 2QH courses ME 3565 and ME 3566. *Prep. ME 3210.*

ME 3565 Gas Dynamics I **2QH**
(formerly 02.823) **As Announced**

ME 3565 and ME 3566 present the same material with the same prerequisites as ME 3564, but in two 2QH courses. *Prep. ME 3210.*

ME 3566 Gas Dynamics II **2QH**
(formerly 02.824) **As Announced**

Continuation of ME 3565. *Prep. ME 3565.*

ME 3568 Computational Fluid Dynamics with Heat Transfer **4QH**

All Spring Quarters, Fall Quarter, Odd Years

Finite difference methods for solving partial differential equations with particular emphasis on the equations of fluid dynamics and convective heat transfer. Integral methods for boundary layers and their coupling to potential flow solutions. Use of coordinate transformations and body-oriented coordinate systems. Application of superposition techniques in convective heat transfer problems. This material is also covered in the two 2QH courses ME 3569 and ME 3570. *Prep. ME 3210 and ME 3410.*

ME 3569 Computational Fluid Dynamics with Heat Transfer I **2QH**
As Announced

ME 3569 and ME 3570 present the same material with the same prerequisites as ME 3568, but in two 2QH courses.

ME 3570 Computational Fluid Dynamics with Heat Transfer II **2QH**
As Announced

Continuation of ME 3569. *Prep. ME 3569.*

ME 3580 Statistical Thermodynamics **4QH**
(formerly 02.904) **Spring Quarter, Odd Years**

This is an introductory course in statistical thermodynamics for mechanical engineers designed to provide insight into the laws of classical thermodynamics and the behavior of substances. Topics to be covered include: introduction to probability; elementary kinetic theory of an ideal gas, including the distribution of molecular velocities and the mean free path treatment of transport properties; classical statistics of independent particles, equipartition of energy, the partition function and laws of thermodynamics; some results from quantum mechanics, quantum statistics of independent particles; applications to gases; introduction to ensembles and systems of interacting particles. This material is also contained in the two 2QH courses ME 3581 and ME 3582. *Prep. ME 3100 and ME 3200 or equivalent.*

ME 3581 Statistical Thermodynamics I **2QH**
(formerly 02.904) **As Announced**

ME 3581 and ME 3582 present the same material with the same prerequisites as ME 3580, but in two 2QH courses.

ME 3582 Statistical Thermodynamics II **2QH**
(formerly 02.904) **As Announced**

Continuation of ME 3581. *Prep. ME 3581.*

ME 3584 Fundamentals of Combustion **4QH**
(formerly 02.927) **Spring Quarter, Even Years**

Comprehensive treatment of the problems involved in the combustion of liquid, gaseous, and solid fuels in both laminar and turbulent flow. The fundamentals of chemical kinetics will be discussed. The equations for the transport of mass,

momentum, and energy with chemically reacting gases will be examined. Topics will include diffusion and premixed flames, combustion of droplets and sprays, and gasification and combustion of coal. This material is also presented in the two 2QH courses ME 3585 and ME 3586. *Prep. ME 3200.*

ME 3585 Fundamentals of Combustion I 2QH
(formerly 02.927) **As Announced**

ME 3585 and ME 3586 present the same material as ME 3584, with same prerequisites, but in two 2QH courses.

ME 3586 Fundamentals of Combustion II 2QH
(formerly 02.927) **As Announced**

Continuation of ME 3585. *Prep. ME 3585.*

ME 3600 Advanced Physical Metallurgy III 2QH
(formerly 02.956) **Spring Quarter, Odd Years**

Mechanical behavior of metals. Application of dislocation theory to micro-plasticity, strain hardening, strengthening mechanisms and creep. *Prep. ME 3251.*

ME 3601 Thermodynamics of Materials III 2QH
(formerly 02.963) **Spring Quarter, Odd Years**

The application of metallurgical thermodynamics to various process metallurgical problems, i.e., gas-solid systems, etc., plus kinetics of reactions and dynamic systems analysis. *Prep. ME 3260 or ME 3261.*

ME 3602 Materials Science and Engineering III 2QH
(formerly 02.972) **Spring Quarter, Even Years**

Continuation of ME 3271 plus a discussion of various special topics that will vary from year to year. Examples are: metastable phases and thin films. *Prep. ME 3271.*

ME 3603 Corrosion 2QH
As Announced

This course will commence with the study of the thermodynamics of corrosion and corrosion reactions both in aqueous and non-aqueous environments. Topics will include thermodynamics, kinetics, and the effects of environment and physical metallurgy. Applications will be made to automotive design, and exterior and interior structures. *Prep. Admission to the Graduate School of Engineering.*

ME 3604 Oxidation 2QH
As Announced

This course will begin with the study of the thermodynamics of oxidation and the effect of environment on rates of oxidation. Topics will include thermodynamics, kinetics, mechanisms, and effect of environment. Ferrous and nonferrous metals as well as polymers will be assessed. *Prep. Admission to the Graduate School of Engineering.*

ME 3605 Electronic Materials I 2QH
Fall Quarter, Odd Years

Generic techniques for fabrication and processing, and the resulting structure-property rela-

tionships, are presented for materials utilized in electronics. Typically included are: bulk single crystals, thin films, metals, semiconductors, and insulators. *Prep. ME 3271.*

ME 3606 Electronic Material II 2QH
Winter, Odd Years

Continuation of ME 3605. *Prep. ME 3605.*

ME 3610 Introduction to Diffraction Methods in Material Science 2QH
(formerly 02.975) **Fall Quarter**

General principles of the diffraction by materials of short wave length radiations; (such as x-ray, electrons, and thermal neutrons) are studied with emphasis on the understanding of the similarities and differences of the different radiations when applied to the study of the structures of crystalline and noncrystalline materials. *Prep. A recent introductory material science course.*

ME 3611 Diffraction Methods in Material Science 2QH
(formerly 02.976) **Winter Quarter**

Continuation of ME 3610 with emphasis on the experimental methods and applications. This includes: choice of radiation, introduction to instrumentation, sample preparation, methods of detection and recording of the diffracted radiation, analysis, interpretation and use of the results. *Prep. ME 3610.*

ME 3612 Microstructure Analysis I 2QH
Fall Quarter, Even Years

Discussion of the principles of scanning and transmission electron microscopy. Image interpretation in transmission electron microscopy with emphasis on the study of the relationships between microstructure and properties of materials. Application of kinematical and dynamical theories of electron diffraction to quantitative analysis of point defects, dislocations, precipitates and grain boundaries etc. Laboratory demonstration of TEM and SEM operation. *Prep. Admission to the Graduate School of Engineering.*

ME 3613 Microstructure Analysis II 2QH
Winter, Even Years

Continuation of ME 3612. *Prep. ME 3612.*

ME 3620 Powder Metallurgy 2QH
(formerly 02.985) **Spring Quarter, Even Years**

Powder characteristics and methods of manufacture. Powder pressing: packing, interparticle bonding, effects of pressure. Principles of sintering. Characteristics and properties of products made from powdered materials. *Prep. A recent introductory material science course.*

ME 3625 Physical Ceramics I 2QH
(formerly 02.965) **Fall Quarter, Even Years**

Introduction to ceramic fabrication processes. Characteristics of vitreous and crystalline solids, structural imperfections, and atomic mobility. Phase equilibria, nucleation, crystal growth, solid-state reactions, non-equilibrium phases, and effects on the resulting microstructure of ceram-

ics. *Prep.* A recent introductory material science course, physical chemistry, or solid state physics.

ME 3626 Physical Ceramics II 2QH
(formerly 02.966) Winter Quarter, Even Years
Discussion of effects of composition and micro-structure on the thermal, mechanical, optical, electrical, and magnetic properties of ceramic materials. *Prep.* ME 3625.

ME 3630 The Structure and Properties of Polymeric Materials I 2QH
(formerly 02.958) Fall Quarter, Even Years
Introduction to the organic chemistry of polymers, effect of chemical composition on structure, melting point and glass transition temperature, polymer characterization and degradation, thermodynamics of polymers. *Prep.* Undergraduate material science course.

ME 3631 The Structure and Properties of Polymeric Materials II 2QH
(formerly 02.959) Winter Quarter, Even Years
Rheology and mechanical behavior of polymers, analysis and testing, effects of processing on structure and physical properties, industrial polymers, resin base composites. *Prep.* ME 3630.

ME 3640 Computer Modeling of Materials Processing 2QH
Fall Quarter, Even Years
This course focuses on the use of numerical methods for modeling a variety of materials processes, e.g. melting, oxidation, reduction, the blast furnace, the cupola, rolling, extrusion. *Prep.* Admission to the Graduate School of Engineering.

ME 3641 Computer Modeling of Materials Properties 2QH
Winter Quarter, Even Years
Various mathematical techniques and computer methods will be used to develop models that describe the changes in a material's chemical, mechanical, and physical properties as the chemical composition and metallurgical variables are changed. *Prep.* Admission to the Graduate School of Engineering.

ME 3797 Engineer Degree Continuation 0QH
Any Quarter

ME 3798 Master's Degree Continuation 0QH
Any Quarter

(formerly 02.9X1)

ME 3799 PhD Continuation 0QH
Any Quarter

ME 3850 Special Problems in Mechanical Engineering 2QH
(formerly 02.992) Any Quarter
Theoretical or experimental work under individual faculty supervision. *Prep.* Consent of department faculty.

ME 3853 Special Topics in Mechanical Engineering 2QH
(formerly 02.993) Any Quarter
Topics of interest to the staff member conducting this class are presented for advanced study. *Prep.* Permission of department faculty.

ME 3856 Doctoral Reading 2QH
(formerly 02.994) Any Quarter
Material approved by the candidate's adviser (only S or F grades will be assigned for this course). *Prep.* Passing of PhD qualifying exam.

ME 3860 Thesis and Seminar (Master of Science Degree) 8QH
(formerly 02.990, 02.991, and 02.998) Any Quarter
Analytical and/or experimental work conducted under the direction of the faculty in fulfillment of the requirements for the degree. First-year students must attend a graduate seminar which will introduce the student to the methods of choosing a research topic, conducting research, and preparing a research report. Successful completion of the seminar is required. *Prep.* Admission to the Graduate School of Engineering.

ME 3870 Thesis (Mechanical Engineer Degree) 10QH
(formerly 02.996) Any Quarter
Analytical and/or experimental work conducted under the auspices of the department. Open to day students only. *Prep.* Admission to the Mechanical Engineer Degree Program.

ME 3880 Dissertation (PhD Degree) 0QH
(formerly 02.995) Any Quarter
Theoretical and experimental work conducted under the supervision of the department. Open to day students only. *Prep.* Admission to the Doctoral Program in Mechanical Engineering.

Pharmacy and Allied Health Professions

Pharmacy and Allied Health Professions

HRM 3815, HRM 3816 Behavioral Concepts and Organizational Behavior I 6 Q.H.

Major concepts and findings of the behavioral sciences with particular pertinence to business and administration, including systematic ways of understanding behavior. Specific topics include human development and motivation, interpersonal perception and communication, and small groups processes. The second half of the course sequence relates these basic concepts to specific aspects of behavior in formally constituted organizations. Supervisory behavior is examined in the behavioral context, as well as in relations between groups, in efforts to develop ways of achieving collaboration. *Prep.: Permission from the Graduate School of Pharmacy and Allied Health Professions.*

INT 3101 Biochemistry I 2 Q.H.

Description of the components of biochemistry, including the chemistry of carbohydrates, lipids, prostaglandins, steroid hormones, amino acids, polypeptides, proteins, purines, pyrimidines, nucleosides, and nucleic acids. Consideration of Henderson-Hasselbalch expression, buffers, and importance of pKa. *Prep.: Two quarters of organic chemistry.*

INT 3102 Biochemistry II 2 Q.H.

Discussion of enzymes, enzyme kinetics, and mechanisms of enzyme reactions. An introduction to the methods used for intermediary metabolism, bioenergetics, biological oxidation-reduction reactions, and the electron transport chain. A consideration is made of carbohydrate metabolism, including the citric acid cycle, the Embden-Meyerhoff pathway, and the pentose phosphate pathway. Use of isotopes in biochemistry and the role of high-energy phosphate compounds are outlined. *Prep.: INT 3101.*

INT 3103 Biochemistry III 2 Q.H.

Lipid metabolism is presented, including the fatty acid cycle, the biosynthesis of fatty acids, and the biological formation of the prostaglandins, cholesterol, and steroid hormones. The metabolism of the various amino acids is considered, including the urea cycle, one-carbon fragments, transamination reactions, and aromatic hydroxylations. Metabolism of nucleic acids and their building blocks are discussed, as well as the genetic basis of protein synthesis, the genetic code, and the mechanisms of control. *Prep.: INT 3102.*

INT 3201 Applications of Mass Spectrometry 2 Q.H.

A comprehensive examination of the principles governing the fragmentation of organic molecules, the interpretation of mass spectra, and discussion of applications of mass spectrometry to the solution of selected problems in the fields of

chemistry, biochemistry, and forensic sciences. *Prep.: 1 year of organic chemistry, basic physics, physical organic chemistry desirable but not essential.*

MLS 3301 Functions of the Human Systems 2 Q.H.

Histology and physiology of respiratory, urogenital, endocrine, nervous, and digestive systems. Lectures supplemented by current research articles and student reports. *Prep.: biology, chemistry.*

MLS 3302 Pathophysiology I 2 Q.H.

Disease processes as appropriate and inappropriate variants of normal physiological functions. A detailed examination of certain important and illustrative diseases rather than a survey or catalogue of diseases in general. *Prep.: Mammalian physiology; knowledge of biochemistry is helpful.*

MLS 3303 Pathophysiology II 2 Q.H.

A continuation of MLS 3302 Pathophysiology I. *Prep.: MLS 3302.*

MLS 3304 Cellular Pathology I 2 Q.H.

A survey of the cell and its components, with emphasis on lesions in cellular function and their causes. Examples will be drawn from both prokaryotes and eukaryotes.

MLS 3306 Biometrics 2 Q.H.

Statistical methods applied to biological samples and analysis of biological research data. *Prep.: None.*

MLS 3310 Principles of Medical Endocrinology 2 Q.H.

Endocrine-related clinical abnormalities with emphasis placed on the relationship of clinical laboratory measurement to biochemical dysfunctions of the endocrine system. *Prep.: Biochemistry.*

MLS 3321 Hematology I—Disorders of the Erythrocytes 2 Q.H.

A detailed examination of the physiology and pathology of red blood cells and hemoglobin. *Prep.: Some knowledge of basic hematology is essential, and familiarity with general mammalian biochemistry is strongly recommended.*

MLS 3322 Hematology II—Disorders of the Leukocytes 2 Q.H.

The pathophysiology of white cell disorders. Clinical and laboratory correlations of leukemias, myeloproliferative and lymphoproliferative disorders, infections, and inherited leukocyte anomalies. *Prep.: Undergraduate biochemistry.*

MLS 3323 Hematology III—Coagulation 2 Q.H.

Clinical and laboratory correlations of coagulation disorders. The use of factor analysis in diagnosis of coagulation disorders. *Prep.: Undergraduate biochemistry, hematology course, or experience.*

MLS 3331 Genetic and Immunologic Aspects of Blood Group Identification 1 Q.H.

Lectures dealing with immune response, physical chemistry of immunohematological tests, immunological diseases, tests for detection and identification of antibodies and antigens, principles of human genetics, blood group genetics, and population and family studies. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 1631 and permission of instructor.*

MLS 3332 Principles and Foundations of the Blood Group Systems 2 Q.H.

Lectures and experience with the human blood group systems, their antigens and antibodies, genetic inheritance and interactions, frequencies, mutants and alterations by disease states, and blood group testing. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 3331, MLS 3531 and permission of the instructor.*

MLS 3333 The Design and Problems of Compatibility Testing 1 Q.H.

Lectures and experience with the design and purpose of compatibility testing; factors complicating compatibility procedure; techniques employed in compatibility testing; leukocyte, platelet, and tissue compatibility; and special crossmatch and transfusion procedures. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 3331, MLS 3531, MLS 3332, MLS 3532 and permission of the instructor.*

MLS 3334 Principles of Hematology and Coagulation Related to Transfusion 3 Q.H.

Lectures and laboratory experience dealing with: hemoglobins; iron metabolism; blood formation; blood volume functions of circulating cells; anemias; leukemias and lymphomas; coagulation theories, factors, and disorders. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: Permission of the instructor.*

MLS 3335 Transfusion Therapy 2 Q.H.

Lectures dealing with selection of blood donors, phlebotomy and pheresis procedures, processing requirements, donor reaction, blood components, physical characteristics of stored blood, indications for transfusion, transfusion reaction, therapeutic phlebotomy and pheresis, autologous transfusions, pediatric transfusions, massive blood replacement, extracorporeal perfusion, cardiopulmonary bypass, and dialysis. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 1631 and permission of instructor.*

MLS 3336 Immunohematology Administration 2 Q.H.

Lectures and experience dealing with standards for blood banks and transfusion services (federal,

state, AABB); requirements for state, FDA, and NIH (BOB) licensing; the American Blood Commission; inspection and accreditation donor procurement; interbank blood exchange; organization of blood bank and transfusion service; medical and legal aspects of transfusion practice; design of physical facilities; evaluation, selection and maintenance of equipment; evaluation and selection of supplies and reagents; preparation; labeling requirements; quality control systems; proficiency testing programs; record keeping; computer principles, use of computer facilities; operations of donor facilities and blood bank laboratories. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 1631 and permission of instructor.*

MLS 3338 Immunobiology 2 Q.H.

Topics of current interest in immunobiology, such as organ transplantation, immune tolerance, autoimmune diseases, and the immunology of cancer. *Prep.: Consent of instructor.*

MLS 3339 Immunopathology 2 Q.H.

The course presents the basic elements for the understanding of clinical immunology and immunopathology. Following a brief review of the components and function of the immune system, the material covered will take into account the current literature relating to the disorders of the complement system, the biologic mechanisms of immunologically induced tissue injury (hypersensitivity reactions), the classification and characterization of immuno-deficiency states, (including acquired immunodeficiency syndrome—AIDS), the modes of induction and diagnostic categorization of autoimmune disorders and the immunological features of cancer. *Prep.: MLS 3338.*

MLS 3341 Advanced Clinical Microbiology I 3 Q.H.

An introduction to the role of the microbiology laboratory in the clinical practice of infectious disease medicine. Major emphasis is on the interaction between laboratory and physician in the diagnosis and control of the more common infectious disease problems. Specific topics include central nervous system infections, infective endocarditis, bacterial sepsis, infectious diarrheas, respiratory tract infections, urinary tract infections, opportunistic and nosocomial infections, and antimicrobial susceptibility testing. *Prep.: Undergraduate course in medical or clinical microbiology or permission of instructor.*

MLS 3342 Advanced Clinical Microbiology II 3 Q.H.

A discussion of the clinical presentation of patients with unusual or rare infectious diseases and the role of the microbiology laboratory in detecting and identifying the causative agents of these diseases. Major emphasis is on mycotic and rare bacterial diseases including actinomycosis, "aty-

pical" mycobacteriosis, granuloma inguinale, leprosy, leptospirosis, melioidosis, mucormycosis, protothecosis, rat bite fever, and relapsing fever. *Prep.: MLS 3341 or permission of instructor.*

MLS 3345 Epidemiology 2 Q.H.

Basic concepts of epidemiology, causes of disease, factors contributed by agents, the human host, and the environment. Acquisition and evaluation of data. Relationship of person, time, and place. Case studies and problems. *Prep.: Consent of instructor.*

MLS 3351 Interpretive Clinical Chemistry 2 Q.H.

Discussions of variables affecting results to be considered when interpreting patient chemistry values. This knowledge is pertinent to the laboratorian in determining the validity of performing a particular assay on a specimen collected or stored under certain conditions as well as determining the feasibility of obtained results for particular patient conditions. The course also includes the typical value patterns seen in various pathological conditions to provide background material on frequently encountered pathological variation. *Prep.: Biochemistry and clinical laboratory experience.*

MLS 3361 Health Science Education I 3 Q.H.

An overview of various aspects of education in the health-related professions to include: design and use of behavioral objectives; evaluation tools (both clinical and didactic); and a survey of various teaching methods. Current journal literature will supplement lecture material. *Prep.: Health Professions major.*

MLS 3362 Health Science Education II 3 Q.H.

Various types of learning packages or self-instructional aids are examined. With the aid of lecture material and independent assignment, each student will design and produce a 15-minute autotutorial and will present it to the class for critique. Current journal literature will also be used. *Prep.: MLS 3361.*

MLS 3365 Medical Laboratory Management I 3 Q.H.

This course was developed to provide an opportunity for medical technologists to prepare themselves for managerial responsibilities. Participants are introduced to basic skills and knowledge appropriate to the administration of a medical laboratory rather than specialized functional techniques. The basic objectives of the concentration are: to confront the student with appropriate learning experiences; to increase skills and knowledge in basic disciplines underlying administrative practice; and to develop judgment and skills in problem analysis and decision making in organizations. Major topics to be discussed include: supervision; operations; organizations; productivity; quality control; human behavior; communi-

cations; personnel management; and environment. *Prep.: Medical laboratory experience or consent of instructor.*

MLS 3531 Genetic and Immunologic Aspects of Blood Group Identification Laboratory 1 Q.H.

Laboratory experience dealing with immune response, physical chemistry of immunohematological tests, immunological diseases, tests for detection and identification of antibodies and antigens, principles of human genetics, blood group genetics, and population and family studies. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 1631 and permission of instructor.*

MLS 3532 Principles and Foundations of the Blood Group Systems Laboratory 2 Q.H.

Laboratory experiences with the human blood systems, their antigens and antibodies, genetic inheritance and interactions, frequencies, mutants and alterations by disease states, and blood group testing. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 3331, MLS 3531 and permission of the instructor.*

MLS 3533 The Design and Problems of Compatibility Testing Laboratory 2 Q.H.

Laboratory experience with the design and purpose of compatibility testing; factors complicating compatibility procedures; techniques employed in compatibility testing; leukocyte, platelet and tissue compatibility; and special crossmatch and transfusion procedures. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 3331, MLS 3531, MLS 3332, MLS 3532 and permission of the instructor.*

MLS 3535 Transfusion Therapy Laboratory 2 Q.H.

Laboratory experience with selection of blood donors, phlebotomy and pheresis procedures, processing requirements, donor reaction, blood components, physical characteristics of stored blood, indications for transfusion, transfusion reactions, therapeutic phlebotomy and pheresis, autologous transfusions, cardiopulmonary bypass, and dialysis. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 1631 and permission of instructor.*

MLS 3536 Immunohematology Administration Laboratory 2 Q.H.

Laboratory experience dealing with standards for blood banks and transfusion services (federal, state, AABB); requirements for state, FDA, and NIH (BOB) licensing; the American Blood Commission; inspection and accreditation donor procurement; interbank blood exchange; organization of blood bank and transfusion service; medical and legal aspects of transfusion practice; design and physical facilities, evaluation, selection,

and maintenance of equipment; evaluation and selection of supplies and reagents; preparation; labeling requirements; quality control systems; proficiency testing programs; record keeping; computer principles, use of computer facilities; operations of donor facilities; and blood bank laboratories. Conducted at the New England Deaconess Hospital Blood Bank Training Center. *Prep.: MLS 1631 and permission of instructor.*

MLS 3538 Immunobiology Laboratory 2 Q.H.
Students are required to undertake individual research projects relating to topics covered in lecture. *Prep.: None.*

MLS 3601 Seminar 1 Q.H.
Topics to be announced quarterly. *Staff.*

MLS 3801 Graduate Research Report I 2 Q.H.
Research of a special topic in medical laboratory science, involving individual research, is undertaken and reported under the direction of a faculty member. *Prep.: Written permission of instructor.*

MLS 3802 Graduate Research Report II 2-4 Q.H.
Continuation of MLS 3801. *Prep.: MLS 3801.*

MLS 3821 MLS Thesis 2-6 Q.H.
Prep.: Written permission of instructor.

MSC 3932 Introduction to Computer Applications 3 Q.H.
A business-oriented introduction to data processing functions and systems. Introduction to the history, terminology, technology, and economics of data management issues in the design, selection, evaluation, and use of computers and computer services. Individual familiarization with elementary computer programming by using either batch or time-shared computer facilities to solve simple business-oriented exercises. When feasible, a visit to a data processing center is conducted. *Prep.: Permission from the Graduate School of Pharmacy and Allied Health Professions.*

MTH 3221 Biostatistics 2 Q.H.
Methods of statistical inference with applications to biology and the medical sciences.

PAH 3101, PAH 3102, PAH 3103 Principles of Medicine I, II, III 6 Q.H. each
An intensive, three-academic-quarter, organ-system-based sequence encompassing anatomy, physiology, pathophysiology, and therapy of disease. (This course is the major component of the second-year curriculum of the Tufts School of Medicine and meets for approximately eighteen hours/week). *Prep.: Admission to Pharm.D. program.*

PAH 3201 Drug Literature Evaluation 2 Q.H.
Principles and practice of drug information, literature retrieval, and evaluation of the pharmacy and medical literature. *Prep.: Admission to Pharm.D. program.*

PAH 3211, PAH 3212, and PAH 3213 Pharmacotherapeutics I, II, III

2 Q.H. each

A three-quarter sequence in advanced contemporary therapeutics of disease. Topics parallel material presented in Principles of Medicine sequence. *Prep.: Admission to Pharm.D. program. Clinical Pharmacy.*

PAH 3221 Psychosocial Aspects of Health Care—Seminar 1 Q.H.
Psychological and social concerns that determine patient behavior and impact on health care. *Prep.: Admission to Pharm.D. program.*

PAH 3231 Pharmacokinetics in Drug Therapy 3 Q.H.
The application of basic and practical clinical pharmacokinetic techniques to patient care. Topics parallel material presented in Principles of Medicine sequence. *Prep.: Admission to Pharm.D. program.*

PAH 3301 Introductory Clerkship I 1 Q.H.
Initial assignment to clinical site. Student rotates through the various clinical laboratories to obtain working knowledge of the role of the clinical laboratory and the data it generates in the management of disease. Emphasis in microbiology, clinical chemistry and hematology areas. Meets approximately four hours/week. *Prep.: Admission to Pharm.D. program.*

PAH 3311, PAH 3312, PAH 3313, PAH 3314 Clerkship I, II, III, IV 4 Q.H., 5 Q.H., 5 Q.H., 5 Q.H.

A four-quarter sequence of advanced clinical clerkship rotations in patient care at various affiliated clinical sites. Students participate in "rounding" activities with medical and other health professionals and have the opportunity to provide drug information in the therapeutic decision-making process. The emphasis in these rotations is on helping students develop skills and familiarity with the application of drugs in the clinical setting as well as the usual progression of disease. Rotations include internal medicine, ambulatory care, pediatrics, psychiatry, and elective experiences. Involves approximately 40 hrs/week. *Prep.: Admission to Pharm.D. program.*

PAH 3321 Patient Assessment 2 Q.H.
General principles of history taking and physical examination. Emphasis is on organ systems of particular importance to the clinical pharmacist in monitoring drug response. *Prep.: Admission to Pharm.D. program.*

PAH 3601, PAH 3602, PAH 3603 Seminar I, II, III 1 Q.H. each
A three-quarter sequence covering topics of relevance to the clinical pharmacy practitioner. Principles of effective communication and teaching are discussed. Students are expected to make oral presentations covering various therapeutic and

related subjects as well as the progress of their investigational projects. *Prep.: Admission to the Pharm.D. program.*

PAH 3801, PAH 3802 Investigational Project I, II **2 Q.H. each**

Students have the opportunity to demonstrate their ability to identify a problem within the domain of clinical pharmacy, formulate a hypothesis, develop methods to collect and interpret the data in order to test the hypothesis, and report the investigation in writing using a thesis format. (Note "Investigational Component of Pharm.D. Program.") *Prep.: Admission to Pharm.D. program.*

PCL 3101 Concepts in Pharmacology **2 Q.H.**

In-depth coverage of the fundamental principles of pharmacology. The course covers pharmacodynamics, including dose-effect relationships and drug-receptor interactions. Pharmacokinetic concepts, including absorption, distribution, and elimination will be presented as well as common pathways of drug metabolism. Other topics to be discussed include pharmacogenetics, drug resistance, tolerance, and physical dependence. An overview of experimental and clinical drug evaluation in humans will be presented. The course is intended as a necessary prerequisite for succeeding courses in pharmacology and toxicology. *Prep.: Admission to a graduate department or approval of the instructor.*

PCL 3111 Special Topics in Pharmacology **2 Q.H.**

An in-depth presentation of current research activity in selected areas of pharmacology. Offered at the discretion of the program. *Prep.: PCL 3101.*

PCL 3121 Experimental Pharmacology **2 Q.H.**

Prep.: PCL 3101 or consent of instructor.

PCL 3131 Receptor Pharmacology **2 Q.H.**

Receptors for drug substances and for endogenous ligands are reviewed in a format that combines lecture presentations and discussion. Considerable emphasis is placed on the evaluation of current literature. The course covers: techniques available to study receptors; various models for receptor-ligand interaction; stereochemical aspects of receptor interactions; receptor-mediated coupling mechanisms; evaluation of several specific receptor systems. *Prep.: MLS 3301, PCL 3101, INT 3101, INT 3102, INT 3103 or permission of the instructor.*

PCL 3141 Pharmacology of Drug Dependence **2 Q.H.**

An intensive survey of the major drug classes subject to misuse and addiction. Lectures emphasize general concepts of tolerance and dependence, the general pharmacology of prototypes of abused drugs, patterns and consequences of abuse in humans, and recent research advances. Selected research papers are critically examined to stimulate quantitative pharmacologic thinking. *Prep.: PCL 3101.*

PCL 3151 Pharmacological Basis of Therapeutics I **3 Q.H.**

A detailed survey of the chemical and pharmacological basis of the major classes and the following characteristics of a prototype agent from each class: indication; adverse reactions; contraindications; structure-activity relationships; metabolism; mechanics of action; clinically significant. Reading assignments cover animal models relevant to therapeutic screening and/or testing and the appropriate design of clinical trials. *Prep.: PCL 3101.*

PCL 3152 Pharmacological Basis of Therapeutics II **3 Q.H.**

Continuation of PCL 3151. *Prep.: PCL 3151.*

PCL 3161 Drug Metabolism **2 Q.H.**

Presentation of the current principles and methods for studying the metabolic transformation and physiological disposition of drugs and other chemicals of pharmacological and toxicological interest. The chemistry of Phase I and Phase II reactions from a mechanistic and empirical viewpoint is covered. The role of structure, bonding, molecular configuration, substitution, and related physicochemical factors in the enzymatic reaction is assessed. The effects of enzyme induction and other factors such as species, sex, and age on the extent of metabolism are explored. *Prep.: PCL 3101 or permission of instructor.*

PCL 3301 Pathology **2 Q.H.**

The student is introduced to the study of the nature of disease, emphasizing the general mechanisms and pathogenesis. Of paramount importance is the effect of disease on the human body. The language of disease is stressed. Basic principles of disease processes and more common special diseases are extensively covered. A research paper may be assigned at the discretion of the instructor. *Prep.: anatomy and physiology.*

PCL 3601 Pharmacology Seminar **2 Q.H.**

Prep.: PCL 3101.

PCL 3801 Pharmacologic Methods I **3 Q.H.**

Students carry out experiments in the laboratory of a pharmacology or toxicology faculty member. The experiments serve to demonstrate the techniques utilized in that lab to study a pharmacologic question. *Prep.: Ph.D. students only.*

PCL 3802 Pharmacologic Methods II **3 Q.H.**

Continuation of PCL 3801. *Prep.: PCL 3801.*

PCL 3811 Research Report in Pharmacology I **2 Q.H.**

A selected research project is undertaken by the student under the direction of a faculty member. *Prep.: PCL 3101.*

PCL 3812 Research Report in Pharmacology II **2 Q.H.**

A continuation of PCL 3811. *Prep.: PCL 3811.*

PCL 3821 Pharmacology Thesis **2-6 Q.H.**

Prep.: Written permission from Program Director.

PCT 3101 Introduction to Biopharmaceutics and Pharmacokinetics 3 Q.H.

An undergraduate course designed primarily to allow students to remedy deficiencies in biopharmaceutics and pharmacokinetics. Factors affecting drug availability from various dosage forms, including bioavailability and bioequivalence of drug products. A quantitative treatment of drug absorption, distribution, metabolism, and excretion, as well as the development of mathematical models for those processes, are also considered. Not available to Hospital Pharmacy majors for graduate credit. *Prep.: Permission of instructor.*

PCT 3111 Clinical Pharmacokinetics 2 Q.H.

Emphasis is placed upon applying various pharmacokinetic techniques to estimating dosage regimens, evaluating drug therapy, consulting on drug selection, and assessing bioavailability and bioequivalence data. *Prep.: A background in biopharmaceutics or consent of instructor.*

PCT 3112 Pharmacokinetics 3 Q.H.

Covers methods used to kinetically analyze the absorption, distribution, and elimination of drugs by biological systems. Compartmental models are dealt with primarily, and the theory of compartmental modeling is developed to permit the solution of moderately sophisticated pharmacokinetic models. The practical aspects of experimental design and analysis are emphasized. *Prep.: Graduate standing and permission of instructor.*

PHP 3101 Hospital Pharmacy Administration I 3 Q.H.

An overview of hospital pharmacy services and an introduction to areas of the hospital that either require or relate to pharmacy services. Inventory, purchasing, and pricing are analyzed both qualitatively and quantitatively. The administrative aspects of materials management, ambulatory care, pharmacy and therapeutics committee, investigational drugs, and pharmacy laws are explored. *Prep.: HRM 3815, HRM 3816.*

PHP 3102 Hospital Pharmacy Administration II 3 Q.H.

Management of a department's personnel and financial resources. Management skills, development of new departmental program, personnel administration and organization are covered, as well as budget preparation, analysis and control, and hospital reimbursement. *Prep.: PHP 3101.*

PHP 3121 Health Care Administration I 3 Q.H.

The socioeconomics and statistics of health care, including governmental programs, legislative trends, third-party insurance and welfare programs, and other areas that may affect the management of the modern institutional pharmacy. *Prep.: Admission to the hospital pharmacy program or consent of instructor.*

PHP 3131 Computer Applications in Hospital Pharmacy 3 Q.H.

An extensive review of past, present, and future applications of data-processing systems to institutional pharmacy. Systems design, evaluation, and proposal development to administrators are discussed with emphasis on the interface between the pharmacy staff, computer systems, and the hospital drug distribution process. *Prep.: 49. 932.*

PHP 3141 Legal Aspects/Federal Legislation in Pharmacy 2 Q.H.

An analysis of the federal and state laws relating to the distribution of drugs in the institution. Included are common-law liabilities such as malpractice and other frequently encountered problems. *Prep.: Admission to hospital pharmacy program.*

PHP 3161 Human Relations in Health Care 2 Q.H.

A study of personnel psychology, organizational structure, wage and performance incentives, employee evaluations, and policy in relation to accepted personnel concepts and procedures. *Prep.: Admission to hospital pharmacy program or consent of instructor.*

PHP 3165 Special Topics in Hospital Pharmacy 2 Q.H.

Selected topics of interest to pharmacy or the health community in general.

PHP 3201 Clinical Pharmacy 3 Q.H.

The patient-oriented aspects of the application of therapeutic agents to hospital patients. An in-depth study of the relation of therapeutic regimens to laboratory tests and drug interactions. The role of the hospital pharmacist as an active member of the health-care team dealing directly with inpatients and outpatients. *Prep.: Admission to hospital pharmacy program or consent of instructor.*

PHP 3211 Contemporary Therapeutics I 3 Q.H.

Recent developments in current therapeutic approaches and their rationale in the treatment of cardiovascular, neurological, gastrointestinal, musculoskeletal, and metabolic diseases of a noninfectious nature. Therapy related to aging and selected genetic diseases. *Prep.: PHP 3201.*

PHP 3212 Contemporary Therapeutics II 3 Q.H.

Current concepts of infectious diseases and the rationale for the chemotherapeutic treatment of these conditions. Diseases of the blood and blood-forming organs, neoplastic disease, and diseases related to deficiency states. *Prep.: PHP 3201.*

PHP 3231 Drug Monitoring 3 Q.H.

The process by which drugs are monitored to determine their effectiveness, safety, prevention of iatrogenic factors, drug-drug interactions, and

matters affecting patient compliance with a therapeutic regimen. The utilization of this information in improving patient care. *Prep.: PHP 3201.*

PHP 3241 Sterile Products 2 Q.H.

Theory principles, methods, and techniques in preparing sterile, pyrogen- and particulate-free products. Equipment and laboratory design required for manufacturing different types of sterile products and the practical considerations essential for their production. *Prep.: Permission of instructor.*

PHP 3601 Seminar on Hospital Pharmacy 2 Q.H.

Seminar on current developments or specific problems in hospital pharmacy that have been studied in depth by students with guidance from the graduate faculty. The student presentations may be alternated with guest speakers on topics of current interest. Student participation in the discussions is an essential objective of the course. *Prep.: Admission to hospital pharmacy program.*

PHP 3801 Hospital Pharmacy Thesis 2-6 Q.H.

Prep.: Written permission of instructor.

PHY 3401 Radiation Physics 2 Q.H.

An introduction to the nucleus and modes of spontaneous radioactive transformation. The isotopic abundance of the elements, naturally occurring radioelements and decay series, the kinetics of decay and the relationship between mass and energy. The nature of the emitted radiation and its interaction with matter. *Prep.: Undergraduate physics.*

PHY 3402 Radiobiology 2 Q.H.

The biological effects of ionizing radiation. Included are a discussion of elementary target theory, radiation chemistry, effects on macromolecules, cellular and chromosomal effects, recovery processes, and the acute and long-term effects of radiation with emphasis on humans, as well as a discussion of environmental sources of radiation and the characteristics of internal and external human exposure. *Prep.: PHY 3401.*

PMC 3101 Chemistry of CNS Depressants 3 Q.H.

Presentation and discussion of the chemistry, structure-activity relationships, and mechanism of action of general anesthetics, hypnotics and sedatives, antiepileptics, analgesics, tranquilizers, and muscle relaxants. A consideration of the mechanics of drug design and methods of modification is undertaken. *Prep.: PCL 3101 or permission of instructor.*

PMC 3102 Chemistry of Autonomic Drugs 3 Q.H.

A discussion of drugs acting on the central nervous system, with special emphasis on the action mechanism of the chemical mediators of the peripheral nervous system. The role of the agents

affecting this system—adrenergic and cholinergic and reversible and irreversible inhibitors of these systems—is discussed in relation to their chemical structure and biological activity. *Prep.: PCL 3101 or permission of instructor.*

PMC 3103 Chemistry of Anti-infectives 3 Q.H.

A study of various chemotherapeutic agents employed in the treatment of infectious diseases. Included are: the sulfonamides, antibiotics, antivirals; antitubercular, antifungal, and antimalarial agents. Special emphasis is on structure-activity relationships, mechanisms of action, and modern research in each area. *Prep.: PCL 3101 or permission of instructor.*

PMC 3104 Chemistry of Cancer Chemotherapy 3 Q.H.

Recent developments in new approaches to both carcinogenesis and to the treatment of cancer are emphasized, including alkylating agents, anti-metabolites, hormones, miscellaneous compounds, and combinations of the above with radiation and immunology. Possible mechanisms of carcinogenesis and chemotherapeutic action explored. *Prep.: PCL 3101 or permission of instructor.*

PMC 3105 Principles of Medicinal Chemistry 2 Q.H.

This course presents basic underlying chemical principles which account for the properties of drugs and an understanding of drug action. Among the principles relating biologic activity to molecular structure that will be discussed are stereochemical properties of the molecules, the ionization constants, the aqueous and lipid solubility, the ability of the molecules to provide bonds, and the ability of molecules to assume different structural conformations on forming these bonds. *Prep.: Biochemistry and organic chemistry.*

PMC 3141 Special Topics in Medicinal Chemistry 2 Q.H.

A special area of medicinal chemistry, including either steroids, CNS compounds, pharmacodynamic agents or chemotherapeutics; their chemistry and structure. *Prep.: PCL 3101 or permission of instructor.*

PMC 3161 Phytochemistry 2 Q.H.

The important classes of chemical compounds produced by plants from the standpoint of their biogenetic origin, detection, isolation, and characterization. Application of these techniques to research in pharmacy, medicine, economics, botany, taxonomy. Introduction to the literature of plant chemistry. *Prep.: Two quarters of organic chemistry and two quarters of biology.*

PMC 3171 Heterocyclic Drugs in Medicinal Chemistry 2 Q.H.

The application of the combined principles of medicinal and heterocyclic chemistry to the synthesis of pharmaceutically useful compounds. The

emphasis of the material presented will be upon a critical evaluation of the literature methods and rationale. *Prep.: Advanced Organic Chemistry I or permission of instructor.*

PMC 3301 Clinical Chemistry and Biochemistry Analysis 3 Q.H.

The broad range of analytes, reagents, and techniques in clinical chemistry and biochemistry are presented. Examples of *analytes* are: proteins (e.g., plasma proteins, receptors), DNA (e.g., pre-natal diagnosis), hormones, neurotransmitters, drugs, carcinogen-DNA adducts, and viruses; of *reagents* are monoclonal antibodies, enzymes, DNA probes, avidin-biotin, and radioisotopes; and of *techniques* are immunoassays, antibody kinetics and specificity, luminescence assays, blotting assays, chemical modification of biomolecules, and methods for biomolecule purification. *Prep.: INT 3101 or permission of instructor.*

PMC 3501 Identification and Isolation of Natural Products and Organic Medicinals 4 Q.H.

A laboratory course in the identification of various types of plant constituents that have medicinal/pharmaceutical use, and the isolation and characterization of known and/or unknown chemical compounds from selected plant samples. *Prep.: At least one year of organic chemistry and some background in plant chemistry, e.g., PMC 1440 or PMC 3161 or by permission of instructor.*

PMC 3511 Advanced Drug Synthesis 4 Q.H.

Application of synthetic and analytical techniques to the formation of new drugs. *Prep.: Two quarters of organic chemistry with laboratory.*

PMC 3601 Medicinal Chemistry Seminar 2 Q.H.

Reports and discussions involving current journal articles and research in medicinal chemistry. *Prep.: PMC 3101-PMC 3141.*

PMC 3641 Biomedical Science Colloquium 2 Q.H.

Presentations on current research in biomedical science and related areas. Included will be the theoretical basis of the problem as well as experimental results obtained. *Prep.: Ph.D. candidate.*

PMC 3642 Biomedical Science Colloquium Continuation 0 Q.H.

Prep.: PMC 3641.

PMC 3651, PMC 3652 Seminar and Report in Clinical Chemistry I, II 2 Q.H. each

Reports and discussions of current journal articles in clinical chemistry. *Prep.: PMC 3301.*

PMC 3801 Medicinal Chemistry Thesis 2-6 Q.H.

Prep.: Written permission of instructor.

PMC 3811 Ph.D. Dissertation 0 Q.H.

Prep.: Written permission of instructor.

PMC 3812 Ph.D. Dissertation Continuation

0 Q.H.

Prep.: Three quarters of PMC 3811.

RSC 3101 Nuclear Medicine I: Instrumentation 3 Q.H.

An introduction to nuclear detection techniques by both lecture and laboratory demonstration. Various systems are considered, including scintillation, ionization, gas, and solid-state detectors. Basic principles of spectrometry with an emphasis on sodium iodide detectors will be studied. *Prep.: PHY 3401.*

RSC 3102 Nuclear Medicine II: Instrumentation 3 Q.H.

A study of the application of nuclear detection techniques in the physical aspects of nuclear medicine. Current clinical instrumentation including gamma cameras and scanners, probes, and whole body counters, as well as future developments such as the solid-state and the multiwire proportional cameras, and positron and tomographic imaging devices. Principles of collimation are studied with each system. The application of computers in nuclear medicine. This course includes both lecture and laboratory demonstration and is a companion course to RSC 3101. *Prep.: PHY 3401 and RSC 3101.*

RSC 3104 Nuclear Medicine:

Radiopharmaceutical Laboratory 2 Q.H.

Demonstrations and discussions of the preparation and quality control of radiopharmaceuticals derived from reactor, accelerator, and generator-produced radionuclides. Assay techniques for radiochemical, radionuclide, and chemical purity. Regulatory implications in the handling and dispensing of radioactive drugs. *Prep.: RSC 3102.*

RSC 3131 Clinical Aspects of Nuclear Medicine 2 Q.H.

The current practice of diagnostic nuclear medicine in large medical centers and small community hospitals. The effect of pathology in the distribution of radiopharmaceuticals will be considered on an organ and disease basis and illustrated with actual patient findings. The techniques employed in imaging the various organs and body compartments will be presented. Factors influencing the decision to perform a diagnostic nuclear medicine procedure and the choice of the agent to be employed will be discussed. *Prep.: RSC 3102.*

RSC 3301 Radioisotopes in Biological Systems 2 Q.H.

Methodology of radioactive nuclides and application of these isotopes to biology and medicine, with special emphasis on their use in clinical analysis. *Prep.: Permission of instructor.*

RSC 3601 Seminar and Research Report in Radiopharmaceutical Science 3 Q.H.

This course provides an opportunity for the students to familiarize themselves with literature

sources and the latest developments in radiopharmaceutical science. A written and oral presentation will be required in a particular area as evidence of an ability to organize and evaluate published material. *Prep.: RSC 3102.*

RSC 3801 Radiopharmacy Internship 2 Q.H.

Designed as a practical on-site introduction to the use of radiopharmaceuticals in the clinical environment, this course offers students an opportunity to participate in various functions of a radiopharmacy, including ordering, preparing, dispensing, and dispersing radiodiagnostics; manufacturing non-routine agents; maintaining quality control procedures; and keeping records. This course is considered a laboratory course, and arrangements for enrollment are usually made on an individual basis with the site of the radiopharmacy subject to approval by the instructor. Offered during all quarters, registration takes place during the fall quarter only. *Prep.: RSC 3104.*

RSC 3811 Radiopharmaceutical Research

Report I 2 Q.H.

A selected research project is undertaken by the student under the direction of a faculty member. *Prep.: Written permission of instructor.*

TOX 3101 Concepts in Toxicology I 3 Q.H.

An overview of toxicology describing the elements of method and approach that identify the science. Special emphasis is placed on the systemic site of action of toxicants. The intent of this part of the

course is to help provide answers to two questions: 1) What kinds of injury are produced in specific organs or systems by toxic agents? 2) What are the agents that produce these effects? *Prep.: PCL 3101.*

TOX 3102 Concepts in Toxicology II 3 Q.H.

Continuation of Concepts in Toxicology I. *Prep.: TOX 3101.*

TOX 3121 Environmental Toxicology 3 Q.H.

The problems of toxic disturbances and distortions of our biosphere are discussed. When appropriate, the mechanism of action of toxic agents and the basis of their selectivity will be examined. Toxic agents are grouped by chemical or use characteristics such as pesticides, food additives, metals, social poisons, chemical carcinogens, teratogens, and mutagens. This course will attempt to provide perspective for the nontoxicologist to the application of the results of toxicologic investigation and a better understanding of those chemicals which, in ever-increasing amounts, threaten health, comfort, or quality of life. *Prep.: Admission to a graduate department or approval of the instructor.*

TOX 3501 Toxicology Lab

4 Q.H.

Companion to the undergraduate course TOX 1320 Toxicology Lab. In addition to the lab work for TOX 1320, graduate students are expected to complete special projects assigned by their adviser. *Prep.: Permission of instructor.*

Academic Calendar 1984-85

September 1984

3	Monday	Labor Day. University closed.
11-12	Tuesday-Wednesday	Fall 1984 registration—Burlington 1:00-3:00, 5:30-8:00
13	Thursday	Fall commencement.
17-20	Monday-Thursday	Fall 1984 registration—Boston 1:00-8:00
24	Monday	Classes begin in Graduate Schools for fall quarter.

October 1984

8	Monday	Columbus Day. University closed.
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November 1984

12	Monday	Veterans Day observed. University closed.
22-25	Thursday-Sunday	Thanksgiving Day recess.
27	Tuesday	Winter 1985 registration—Burlington 1:00-3:00, 5:30-8:00

December 1984

3-6	Monday-Thursday	Winter 1985 registration—Boston 1:00-3:00, 5:30-8:00
10-14	Monday-Friday	Final examination for Graduate Schools.
17-January 1	Monday-Tuesday	Christmas vacation.

January 1985

1	Tuesday	New Year's Day celebrated. University closed.
2	Wednesday	Graduate classes begin—4:00 p.m. or later.
15	Tuesday	Martin Luther King, Jr.'s birthday. University closed.

February 1985

18	Monday	Presidents' Day. University closed.
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March 1985

5	Tuesday	Spring 1985 registration—Burlington 1:00–3:00, 5:30–8:00
11–14	Monday– Thursday	Spring 1985 registration—Boston 1:00–3:00, 5:30–8:00
18–22	Monday– Friday	Final examinations for Graduate Schools.
25–30	Monday– Saturday	Vacation period.

April 1985

1	Monday	Graduate classes begin—4:00 p.m. or later.
15	Monday	Patriot's Day. University closed.

May 1985

27	Monday	Memorial Day. University closed.
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June 1985

10–11	Monday– Tuesday	Summer 1985 registration—Burlington 5:30–8:00
12–13	Wednesday– Thursday	Summer 1985 registration—Boston 5:30–8:00
10–14	Monday– Friday	Final examinations for Graduate Schools.
16	Sunday	Commencement.
17–22	Monday– Saturday	Vacation period.
24	Monday	Graduate classes begin—4:00 p.m. or later.

July 1985

4	Thursday	Independence Day. University closed.
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September 1985

2	Monday	Labor Day. University closed.
3–6	Tuesday– Friday	Final examinations for Graduate Schools.
12	Thursday	Fall commencement.
9–14	Monday– Saturday	Vacation period.
16	Monday	Beginning of 1985–86 academic year.

Calendar dates are subject to change. The University community will be notified if such changes are necessary.

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